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THE COLORADO AND ILLINOIS CONVENTIONS.

If all State electrical associations could round up at conventions as large a proportion of the active membership as those of Colorado and Illinois both held last week, banner records would be made for the great majority. The number of companies in the territory of the Colorado Electric Light, Power & Railway Association is not large in comparison with some Central and Eastern States, and Western distances are "magnificent." These handicaps and the necessarily limited membership did not prevent the convention from comparing favorably in attendance with Eastern State conventions. A very commendable feature of the convention was the avoidance of the too common attempt to crowd a large number of long papers into the limited time available, thus making proper discussion impossible. Plenty of time was allowed at Denver for the discussion both of papers and Question Box queries. The convention was notable rather for the large number of little practical points brought out than for the treatment of broad engineering questions, which latter are usually out of place at meetings of central station managers.

The Illinois convention had an excellent programme and of such a compass that there was time for much discussion, which formed a valuable part of the proceedings. A feature of the convention was the straightforward remarks of Mayor Devereux, of Springfield, in favor of private as opposed to municipal ownership of public utilities. The most notable contribution to the proceedings was the report of the insurance committee, which indicates what can be done in securing amelioration of insurance rates by the united action of central station companies. In the present instance a new schedule was obtained effecting a large reduction in the cost of central station insurance. The report and the discussion which followed its presentation will be found of much interest and value by all central station men.

THE DESIGN OF SUSPENDED-NEEDLE GALVANOMETERS.

The suspended needle type of Kelvin galvanometer is now rarely seen or used. It is not quite extinct, but it is generally found on the historical shelves of electrical instrument collections. It has been relegated to innocuous desuetude by the ubiquitous and deadly trolley. Only a few years ago almost every electrical laboratory mounted at least one Kelvin astatic galvanometer with its suspended needle system and controlling magnet. But the trolley car came down the road, and even if that road was a mile off, the suspended needle began to dance and quiver until finally the instrument was replaced by a galvanometer of the suspended coil or D'Arsonval type. A few electrical men fought the intruding magnetic fields. They built walls of soft iron around their suspended needle galvanometers and looked at each suspended mirror through a telescope and a peep-hole in the iron wall; but although this expedient might serve occasionally, yet it was clumsy at best and resembled the coats of armor or steel vestments with which the knights of old first tried to repel bullets. After a time no one who believed in keeping out bullets by iron armor survived to make proselytes. Nevertheless, when the highest degree of sensibility is required, the suspended-needle form of galvanometer easily beats the suspended-coil form. In

order to avail himself of the most highly sensitive galvanometers, the electrician must set up his needle instrument out in the wilds beyond trolley reach. There are still localities in North America where one may mount such an instrument in peace, and here the old-time rules and precautions for securing astatic sensibility and a high figure of merit may be indulged in once more.

Prof. L. A. Freudenberger, in an article on page 607 develops along special and interesting lines the once well-known formulas for maximum sensibility in needle galvanometers. It is evident that if the insulating coat on winding wire had no thickness—that is, if the silk covering could be made indefinitely thin—it would be desirable to use as fine a copper wire as possible, in order to get the maximum deflection per micro-ampere of current through the coil. But owing to the rapid loss of winding space in insulation, or the rapid rise of covered to uncovered ratio in the wire as the wire becomes finer, it becomes desirable to stop at about No. 36 wire, five mils in diameter, with the thicknesses of silk insulation which are in present commercial use. It is also interesting to observe that the four-bobbin suspended-needle galvanometer is capable of being made distinctly more sensitive than the ordinary two-bobbin galvanometer—a fact that certain instrument makers abroad have availed themselves of; and that grading the wire is of less importance in such multiple-bobbin instruments.

Directed Wireless Telegraphy.

It is universally admitted that a convenient method of directing wireless telegraph waves into a single beam, like that of a searchlight, instead of scattering them in all directions like the rays of a candle, would be of great importance to the art of electric communication. For one thing it would go far to prevent interference between neighboring disinterested signaling stations. It has to be remembered, however, that a telegraph wire between the two communicating stations performs this very function. That is, a telegraph wire conducts all the electric waves in one beam or channel from the sender to the receiver. In seeking for directed wireless telegraphy we therefore seek a substitute for the connecting wire. A step in the direction of channeling wireless telegraph waves has been made by employing bent antennas; i. e., antennas which rise vertically to a certain height and then are carried in a horizontal straight line. Such a bent antenna may be regarded as a cross between the ordinary upright antenna and the original horizontal antenna of Hertz. The effects produced might be expected to be some combination of the individual effects of these two devices. In the article by Mr. H. J. Round, appearing on page 567 of the issue for September 22, an estimate of the summation is attempted.

The writer shows that the curve of quantitative directive results with the bent antenna approximates to the sum of a simple central circle and a pair of oppositely signed equal circles resting in contact at the center of the first. In a general way this proposition may be admitted and the fair agreement reached between this summation and the observations gives confirmation. The actual conditions, however, must be much more complex, if only for the reason that the phase of the currents in the horizontal part of the bent antenna necessarily differs from the phase of the current in the vertical part. Consequently, the action must be a pulsating one, and not a simple harmonic distribution. The analysis has been worked out by Fleming to a further degree of approximation and the formulas reached, although very complicated, have been shown to present recognizable features of resemblance with experimental results. It is fairly evident from the mathematical theory that the degree of directedness in the waves, that is, the ratio of the maximum strength in one horizontal direction to the minimum in a perpendicular direction, will vary with the distance. At short ranges we should expect the degree of directedness to be larger than at long ranges. At very long ranges the ratio should sink substantially to unity. Experiments have yet to be made to show whether the effects produced at long range are appreciably greater than would be produced by the vertical part of the bent antenna acting alone. In the meantime it should be possible to determine at a coast station the direction of a distant invisible steamer by arranging a plurality of receiving antennas at equal distances around a circle of say 400 meters diameter, with the observing station at the center. By connecting successive pairs of diametrically opposite antennas, while the distant vessel continues to send signals, it should be quickly possible to find one pair, or diameter, on which the received signals should vanish; while on each side of this neutral diameter the signals should increase in strength to a maximum. The maximum diameter should be the diameter on the prolongation of which the steamer lies, while the neutral diameter should lie at right angles to this direction.

The Hysteresis Exponent Experimentally Determined.

The waste of power occurring in electrical machinery is all due to the establishment of oscillations in atomic or subatomic material particles. In transmitting power electrically we seek to produce movement in masses or solid bodies by setting the ether in wave motion. The steady movement of waves, over wires, through the ether, involves no loss. The steady movement of masses of matter involves no loss. Incidentally, however, we can neither set up wave motion in the ether over wires without moving electrons in the substance of the wires; nor can we move masses of matter continuously without rubbing atoms into oscillation at friction surfaces. Moreover, we cannot continuously move iron in a magnetic field without setting up oscillations among the countless atomic magnets of which iron is supposed to be composed. It follows that we cannot convey power from one material system to another without submitting to a certain incidental but inevitable loss in the movements of atoms. We seek to produce the bodily movement of large masses, and we have to sustain a certain amount of parasitic movement of ultramicroscopically small masses.

When the parasitic oscillations of the atoms is produced by the friction of masses, as in journals or windage, we call the loss of power mechanical. When the oscillations are produced by the collisions of electrons, as in the heating of active conductors, we call the loss electrical. When the oscillations are produced by cyclic magnetic changes we call the loss magnetic or hysteretic. The frictional losses are usually the greatest in a dynamo-electric machine. But where friction does not occur, as, for example, in transformers, the hysteretic losses are ordinarily the greatest. It thus becomes a matter of engineering importance to study the laws of hysteresis carefully, with a view to reducing hysteretic waste of power as far as may be commercially possible. The law of hysteretic loss increase with increase of magnetic flux density is peculiar in that it is more than the first power and less than the square. It does not seem to be any exact power, but the exponent is in the neighborhood of 1.6. This number is usually accepted for practical purposes. At high densities the value of the exponent seems to differ slightly from the value at low densities. The reason for this exponent of 1.6, or thereabouts, is not clear, although there have been several explanations suggested. The exponent appears to be connected with the theory

of probabilities, and with the behavior of crowds of molecular permanent magnets scattered through the substance of iron, and left to their mutual magnetic influences in addition to the external cyclic magnetizing force. No simple and convincing explanation of the exponent has yet reached us.

In the article we publish this week on page 609 Mr. E. L. Weber elaborates an experimental method of determining the value of the hysteretic exponent in a choking coil, or transformer, of closed magnetic circuit. The plan is to measure the losses at constant impressed voltage at three different known frequencies. By this means, if we admit that the eddy-current losses in the iron core of the transformer remain constant, the hysteretic exponent may be evaluated. The method is unexceptionable if carried out with sufficient care; but it is open to several objections if great care is not taken. The formula shows that the exponent depends upon the differences between wattmeter readings in the three successive tests. In order to secure good, large differences in the wattmeter readings, the three frequencies employed should differ considerably. Errors may be involved if the wave form of the impressed e.m.f. differs appreciably in the three cases. Again, the iron core should have uniform cross-section; or be toroidal, if possible, since otherwise differences of flux density may give rise to erratic differences in eddy-current distribution. Again, the temperature of the core-plates must be kept substantially the same in all three tests, or the eddy-current losses will differ in the different trials. Finally, the thickness of the core-plates must be so small that variations in magnetic density, or skin effect, may have negligible influence at the highest frequency employed. A skin effect which might be of but little commercial importance might appreciably vitiate the final results.

WIND PRESSURE.

Mr. Bowie's paper on this subject, printed elsewhere, shows the danger of jumping at conclusions in physical investigations. The pressure due to wind has very long been a subject of debate and investigation, but even up to within a few years the data have been terribly at variance. The value of wind pressure in terms of velocity is a factor of fundamental importance in all attempts at very high-speed traction, yet it remained practically unsettled until the concurrence of the Zossen tests with the data obtained by artillerists gave proof of the maintenance of fairly uniform conditions over a very wide range. Even so the variation of pressure with the shape of the surface affected remained practically unknown save for the empirical data applicable to a few bodies of particular form and dimensions. The experiments cited by Mr. Bowie are illuminating not so much for what they teach of theory as in showing the imperfections of all theories yet set forth. While we should hesitate to accept the results obtained from Pitot tubes and the like as being absolutely conclusive, they are certainly important and show very plainly that the customary estimation of wind pressure on curved surfaces involves considerable errors. Fortunately, the errors produced are in a safe direction, leading to pressures somewhat too high rather than too low, so that their net result is slightly to increase the factor of safety. Hence, no serious results have actually followed from using an incomplete theory.

As usually happens, the customary considerations of wind pressure failed in its premises. The fact is that save in formal acoustics, air motion has not generally been treated as the flow of a compressible fluid, but as a mass in rectilinear motion, a mass made up of molecules to be sure, but still to be treated by the laws of molar physics. Stream lines in air are hard to locate and harder still to evaluate for their dynamical effect. Any one who has seen the beautiful photographs of projectiles in flight made by Von Rudiger and others comes to a sudden realization of the nature of air and its distribution of energy as a compressible fluid. It is hard to comprehend at first that a missile no bigger in diameter than a lead pencil carries with it compressional head waves forming a parabolic surface six or eight inches in diameter, and leaves behind it a turbid wake as sharply marked as that of a torpedo boat. At lower velocities, below that of sound, these waves cease to be static with respect to the projectile and cannot be photographed by their differences in density, yet the system of stream lines is no less complicated though enormously difficult to investigate. One can follow the motion to a certain extent by entraining smoke with the air, but in the ordinary investigation of wind pressure problems the stream lines have been almost universally neglected. In the detailed study of air flow by tubes very small with respect to the entire surface, a god deal of valuable information can be obtained, at least within the limitations imposed by the disturbing effect of the tube itself, which can be for many purposes neglected. It is highly probable, however, that the results obtained experimentally are greatly influenced by the smoothness of the surface and by its absolute dimensions with respect to the velocity. This indeed appears from the equation obtained by Finzi and Soldati in the terms involving powers of the perimeter. Bodies relatively very short, such as they employed would behave again quite differently from elongated bodies in which the contour of the wake would change rapidly with the velocity.

It is desirable, as Mr. Bowie suggests, to get data on wind pressure directly from the deflection of suspended wires. In electrical engineering the wind pressure comes up chiefly in the construction of pole lines, and in the long spans now coming into considerable use the factors of safety have to be more carefully considered than in the older constructions. If, as seems likely, aluminum with its increased cross-section and low elastic limit comes into extensive use, a careful evaluation of wind pressure on spars actually in place should be extremely useful. It is certainly pertinent, too, to inquire whether at practical wind velocities there is material difference between the pressure upon cylindrical wires and cables. Probably not, yet if the difference should become perceptible at all, it would be at the dangerous velocities. Pole lines also must be considered with reference to wind pressure, especially when they are of steel towers supporting long spans of cable. So far as electric traction is concerned, the fundamental data are in fairly good shape, but much remains to be learned concerning the design of locomotives and trains for minimum air resistance. Even in automobile design the nature of the air currents are important both as bearing on resistance and upon the effect upon the road surface, so that the whole subject of air flow about bodies in motion deserves close attention. The recent steps in advance noted by Mr. Bowie are of importance, and investigators should press on in this direction. The chief difficulty is the lack of any easy method of experimentation applicable to moving bodies in general, or to stationary bodies in powerful air currents. Detailed study by pressure tubes is good as far as it goes, but its fault is that it is at best only a point-by-point method and difficult to apply when much ground has to be gone over. The subject is certainly of sufficient practical importance to encourage further investigation, and the sooner it is put upon a scientific basis the sooner valuable practical results will appear. At least a fair start has been already made.

Philadelphia Section of the Illuminating Engineering Society.

The Philadelphia Section of the Illuminating Engineering Society was organized at the rooms of the Engineers' Club, 1122 Grand Street, on Friday evening, September 14, 1906. The Committee on Organization, consisting of Messrs. W. H. Johnson, Wm. C. L. Eglin, Paul Spencer and James T. Maxwell, had given much time to the work of creating interest in the various branches of the lighting industry, and their efforts were rewarded on the opening night with a roll of members in good standing amounting to 105. The following officers and directors were elected:

President, Mr. Horatio A. Foster; vice-president, Mr. Isaac H. Francis; secretary, Mr. Walton Forstall; treasurer, Mr. Harold Calvert. Directors: Messrs. H. J. Buddy, Benjamin L. Cates, R. J. Rolston, John B. Klumpp, and James T. Maxwell.

After the election and appointment of committees, 15 applications for membership were received, making a total of 120 members.

The section will meet on the third Friday evening of each month, excepting June, July and August. The meeting of October 19 will be devoted entirely to the reading and discussion of papers.

The Third Rail of the Atlantic City Electric Road.

The electric system of the West Jersey & Seashore Railroad between Atlantic City and Camden, N. J., has just gone into operation on regular schedule. The Pennsylvania Railroad owning this branch has been at great pains to cover the third rail wherever the road comes into or crosses public property; as well as at other places where it is accessible to the public. To be injured by it, a person will have to go to a good deal of trouble. At or near stations, where the tracks are necessarily open to the public, no one can touch the third rail unless he deliberately shoves hand or foot through an opening between the wooden guards on the top and at the sides.

The greater part of the sixty-five miles of double track road runs through property owned by the West Jersey & Seashore—in other words, through private property. On both sides, the tracks are separated from the abutting property by stout fences. To reach the tracks it would be necessary to climb the fence and become a trespasser.

Wherever the railroad tracks cross a public street or road, the side fences turn in toward the railroad track, and across the tracks themselves and meeting the fence, is a "cattle guard." This extends along the track for eight feet on each side of the road, and no one can reach the private property of the railroad, and therefore, the third rail, without the uncomfortable process of walking over the "cattle guard." That is very difficult, for the ordinary roadbed gives way to edged terra cotta blocks on which it is next to impossible for cattle of any description to gain a foothold.

The third rail never continues across a public highway, but stops five feet back of the property line. The current is carried under the highway by connecting wires. With contact shoes on all cars, a train is able to maintain continual connection with the third rail at the crossings.

Unusual precautions have been taken to protect the third rail at stations. In front of the stations and for a considerable distance beyond in both directions it is covered over the top by a board, and directly opposite the platforms there is an additional covering on the side. The "shoe" attached to the car goes under the top covering to make contact with the charged rail. If a man happened to be walking along the side of the track and fell over the third rail he would not be hurt, because the wooden covering would protect him.

The two third rails, necessary to the two tracks, are on the inside, that is between the tracks. At stations there is a fence between the tracks and where there is an opening in this fence to permit passengers to cross from one platform to another the third rails are discontinued at the gap in the fence, and connected by underground cable in the same manner as at all of the crossings along the route.

The cars on the Camden-Atlantic City Line have contact shoes on both sides, and the shoes on the opposite side from the third rail are charged as well as those which touch the rail. This means that when a train rolls up to a station there are charged shoes on the platform side, as well as on the other. The Railroad Company has taken the same precaution to protect these shoes as it has to protect the third rail. A piece of wood slanting down over the shoe from the side of the truck affords a covering at the station and thus protects the shoe from the top and the station platform itself projects so as also to cover the shoes. By this means it is impossible for a passenger to get at the shoe even if he tried.

The third rail is protected on station sidings, for the sake of employes, just as it is in front of platforms. Along the "team tracks" too, where freight is loaded and unloaded, the same measures have been taken.

The third rail gives way to overhead trolley wherever the electric road parallels public streets, as in Camden, the western terminus, Vineland and Millville. When the current comes from the trolley the contact shoes are not charged at all, as there is a switch in the car to disconnect them from the circuit when the third rail ends.

In Atlantic City from the terminus to the point where the tracks go upon the elevated structure, the third rail is protected all the way. Even up on the "filling," the approach to the elevated structure, with high embankments on both sides, the wooden coverings are installed. The crossings at Ohio Avenue, Indiana Avenue, Illinois Avenue, Kentucky Avenue and the rest are just as they would be if trolley wires furnished the current.

The Mardi Gras at Coney Island.

Coney Island ended its season of 1906 with the greatest fête the world-famed strip of sand at the entrance to New York harbor has ever known. Surf Avenue was hidden behind hundreds of thousands of yards of bunting and myriad incandescent lamps, and the daily press has told how, under showers of confetti, Prince Plenty and Queen Prospera were superbly crowned and led their splendid frolicsome march from one end of the island to the other during the carnival week which ended September 22.

This six-night pageant surpassed every other brilliant scenic effect ever made in the world of fun about New York, and it was electricity that first of all made it possible. Coney Island is bright enough by night ordinarily, in fact it is the brightest spot in the world, and the old phrase used time and again in exaggeration that Coney Island at night was as bright as by day could be spoken with somewhat more truth during the carnical week.

The gorgeous carnival procession was more than a mile long and included twenty floats bearing groups of figures typifying some passages in the "Carnival of Plenty," of which the procession was a part. One thousand people and two hundred and fifty horses took part in the nightly pageant, exclusive of those upon the floats and in special costumes. No care or expense was spared to costume appropriately and carry out artistically the designs of the person who planned the color effects and groupings of the pageant. Prizes were awarded for the best schemes of display in the decoration of houses, stores and blocks in consequence of which the entire route of the parade was an arcade of bunting and decorations. It is estimated that the aggregate number of persons who witnessed the festival was over 2,000,000.

In addition to the ordinary electrical illumination, huge searchlights were mounted at points of vantage, and the number of incandescent lamps on the buildings was considerably increased. The Edison Electric Illuminating Company, of Brooklyn, which generates all the electricity consumed on the island, furnished and maintained free of charge during the week forty arc lamps and 6,500 incandescent lamps. The latter were festooned across the roadway on which the parade was held in such a way as to give a very pretty effect.

The N. C. F. Ownership Inquiry.

As already noted, fifteen members of the committee of Twenty-one, of the commission on public ownership and operation of the National Civic Federation, sailed from New York on May 22, and completed their work abroad in six weeks. They began their itinerary—arranged in advance by Messrs. Maltbie and Sullivan, who, with eight experts, had preceded the committee three months—at Dublin, and concluded their labors at the city of London.

In all their examinations the committee consulted with the engineers and accountants. Not only did these technicists accompany the committee upon its visits to the many plants inspected, but they were also engaged—in pairs, the one the nominee of the pro, the other of the anti members—in completing the critical examination of the plants coming under their respective jurisdictions. The experts were: Street railways: Norman McD. Crawford, Hartford, Conn; gas: J. R. Klumpp, Germantown, Pa.; Wm. Newbigging, Manchester; electric light and power: J. H. Woodward, London; A. E. Winchester, South Norwalk, Conn. Messrs. Marwick, Mitchell & Co., New York and London, and Robert C. James, Wallingford, Pa., accountants. Labor conditions in the plants chosen for investigation were investigated by Prof. John R. Commons, Wisconsin University, and J. W. Sullivan, editor of *The Clothing Trades Bulletin,* New York.

The data these experts were required to obtain had all been indicated beforehand in very comprehensive schedules, described in the April number of *The National Civic Federation Review.* The committee will be largely guided by these and the American schedules in framing its final report. The cities visited and the kind of plants examined were as follows: Dublin—street railways, private. Glasgow—street railways, public; electric, public; gas, public. New Castle-on-Tyne, electric, private; gas, private. Manchester—electric, public; street railways, public; gas, public. Leicester—gas, public; electric, public; street railways, public. Sheffield—gas, private. Birmingham, gas, public. Liverpool—electric, public; street railways, public. Norwich, street railways, private. London—electric, public and private; street railways, private; gas, private.

At Glasgow the committee's work was especially promoted by the fact of its having the very friendly co-operation of Manager Dalrymple, of the city's tramways. At London similar assistance was rendered by Sir Clifton Robinson, whose interests in private companies is not exceeded by those of any other man in Great Britain. Hearings were held at London at which leading exponents of company management were heard. Among those who attended these hearings were Lord Avebury, Mr. Sydney Morse, president of the Chamber of Commerce; Mr. Emil Garcke, of the Industrial Freedom League; Mr. Dixon H. Davies, solicitor; and Mr. Robert P. Porter, of the London *Times.* The principal exponents of municipal ownership were also heard. Among the latter were Mr. T. McKinnon Wood, of the London County Council; Mr. J. Allen Baker, chairman of the London Municipal Tramways; Mr. Robert Donald, of the London *Chronicle,* and the Rt. Hon. John Burns, who is president of the Local Government Board.

From the very beginning great interest was manifested in the work of the commission. Boards of trade, private companies, city governnments, labor leaders, members of Parliament, officials of the National Government, representatives of rate payers' associations—all seemed interested, and every facility was placed at the command of the committee. The general sentiment was that the report of the commission should be of no less value to the people of Great Britain and Ireland than to the people of America. The fact that so many men drawn from different walks of life, and of such diversity of opinion, could be gotten together and dispatched upon so important a mission, was much commented upon; as was the further fact, that they had set out to determine the actual conditions in each case, by employing a corps of engineers and accountants. In short, the commission and its sponsor, the National Civic Federation, were warmly commended for having undertaken a work of such manifest importance to cities.

The last meeting held in London adopted a resolution outlining a plan for the accomplishment of the remaining work of the committee. This resolution provides: That, as schedules are completed copies of same to be promptly furnished members of committee; that Dr. Maltbie prepare a history of parliamentary action in relation to the municipal utilities under investigation; Prof. Goodnow, a report on political conditions in the municipalities of the United Kingdom as compared with such conditions in the United States, same to include a discussion of the relation of said political conditions to public and private operation of the particular municipal utilities; Profs. Bemis and Parsons and Messrs. Walton Clark and Edgar, either jointly or individually, such statements for the plants investigated here and abroad; that the schedules for each plant be collated in a clear, concise statement for the use of the committee in drafting its report; that the officers of the committee prepare a general statement of conclusions and recommendations that may be used as a basis of discussion and adoption with such emendation as the committee may order, etc., etc.

In this country the work of investigation is almost completed. The cities that have been visited are: Wheeling, Allegheny, Indianapolis, Chicago and South Norwalk; a number of other cities have been examined by the experts and by members of the committee whose work has been specialized. The experts employed in the American investigation are: Gas, J. R. Klumpp; Fred C. Burnett, Toronto; A. E. Farstall, New York: electric light and power, C. E. Phelps, Jr., Baltimore; Theo. Stebbins, Columbus, Ohio; A. E. Winchester, South Norwalk, Conn; water, Dabney H. Maury, Peoria, Ill.; accountants, Marwick, Mitchell & Co. A report upon the Massachusetts method of regulating the electric lighting industry is being prepared by Alton D. Adams, Worcester, and C. I. R. Humphreys, of Humphreys & Glasgow, New York.

Expert work not technical in character in relation to the plants selected, is being performed by Prof. John H. Gray, Northwestern University, and Walter L. Fisher, of Chicago, has prepared a report upon the history of the municipal lighting plant of that city; Prof. Leo. S. Rowe, University of Pennsylvania, has made a similar report on the gas question in Philadelphia. The special investigation into labor conditions is now being completed by Prof. Commons and Mr. Sullivan. It is expected that Cleveland, Philadelphia and one or two other large cities will be visited by the committee within the next thirty days.

After having completed the work outlined above the subcommittees provided for in the resolution referred to will complete the duties assigned them. This will be followed by one or more meetings of the committee, at which its report will be drafted. At the present time the work of collating the matter contained in the completed schedules—the data gathered by the experts—in such a way as to make its assimilation more easy, is now being proceeded with. It is expected that the committee will be ready to submit its report to the entire commission about December 1.

Convention of the Colorado Electric Light, Power and Railway Association.

The Colorado Electric Light, Power & Railway Association held its fourth annual convention at Denver September 18, 19 and 20, 1906. Sessions were held in the assembly room of the Denver Gas & Electric Company's building. Mr. F. W. Frueauff, of Denver, president of the association, being in the East on urgent business, the sessions were presided over by Mr. William Mayher, of Greely, vice-president.

The first session was called to order at 11.20 Tuesday morning and was opened by roll call. The secretary, Mr. George B. Tripp, of Colorado Springs, then read a short message or address from the absent president.

President Frueauff stated in this address that the association had now in this its fourth year an active membership of 32 companies and an associate membership of 32. The recent amendment to the by-laws whereby companies from adjoining States could come in has served to cause several such companies to join the association.

Rendering good service is the first thing in maintaining public

favor. He urged companies to use foresight and order apparatus long enough in advance to allow for the crowded condition of manufacturers and the distance from sources of supply. He favored the establishment in Colorado of a State Gas & Electric Light Commission similar to that in Massachusetts as the best solution of troubles arising from unfair rate regulation and competitive plants. The convention then adjourned until afternoon.

At 2 p.m. Mr. E. P. Dillon, of Colorado Springs, read a paper on "Transformer Testing and Line Records for Transformers." Following this Mr. W. A. Carter, of Denver, read a paper on the "Use of Polyphase Motors in Outlying Districts," in which he described some changes from direct to alternating-current service recently made in some parts of Denver. The remainder of the session was taken up with a discussion of the questions in the Question Box.

Wednesday morning was largely devoted to illuminating engineering. Mr. J. R. Cravath, of Chicago, presented a short paper on the "Lighting of Small Stores." Mr. W. D'A. Ryan, of West Lynn, Mass., followed with a talk on problems which come up in connection with larger stores. After the discussion of these the Question Box was again taken up.

On Wednesday afternoon Mr. C. C. Chapelle, of Denver, read a paper on "Steam Turbines," and the Question Box then was taken up for the remainder of the session. A nominating committee was appointed consisting of Messrs. Chas. Neely, C. K. Durbin and A. M. Ballou. After adjournment the Denver City Tramway Company placed a car at the disposal of the visitors for the purpose of taking them to its power station in the northern part of the city.

Thursday morning the Question Box was again taken up. After an extended discussion of the questions a paper on "Voltage Regulation" was presented by Mr. Leonard Wilson, of Denver, which gave a comprehensive review of the methods of voltage regulation used on alternating-current circuits. Mr. A. M. Ballou, of Denver, gave a paper on "Water Type Lightning Arresters," describing a novel practice of the Denver City Tramway Company in placing a tank lightning arrester on each car to be cut in during severe thunderstorms. These arresters have been in use three seasons and have resulted in a very great reduction in motor burn-outs by lightning, and make it possible to operate during thunderstorms where previously they would simply have to shut down until the storm subsided. After a discussion of this the convention went into executive session.

On Thursday afternoon a brief session was held to elect officers and hear the reports of committees. Secretary Tripp, in his report, showed that with 11 new active members the roll now stood 37 active and 32 associate members. The treasury is also in satisfactory condition with a balance of $662.

The following officers were elected on recommendation of the nominating committee: President, Mr. Geo. B. Tripp, of Colorado Springs; vice-president, Mr. W. G. Matthews, of Denver; secretary and treasurer, Mr. John F. Dostal, of Denver. Executive Committee—The officers and Messrs. F. W. Frueauff and John A. Beeler, of Denver. Finance Committee—Messrs. John F. Vail, of Pueblo; Wm. Mayher, of Greely, and Mr. E. P. Dillon, of Colorado Springs. Membership Committee—Messrs. J. W. Stearns, of Denver; F. C. Webber, of Leadville, and M. T. Morrell, of Golden. Advisory Committee—Messrs. W. J. Barker, of Denver; Irving Hale, of Denver; L. M. Cargo, of Denver; W. T. Wallace, of Canon City, and V. D. Sickman.

The convention then finally adjourned. After adjournment, by courtesy of the Denver City Tramway Company, the party was taken to visit one of its latest types of sub-station on the Colfax line and later to Golden and the foot hills.

Mr. Geo. B. Tripp, the newly elected president, has been secretary for several years past and has undoubtedly done more for the association than any other man. He has managed the central station company at Colorado Springs for several years and only recently resigned to become associated with Curtis & Heine, of that city, who control a number of electric properties in Colorado and elsewhere. He was formerly at Cleveland, Ohio, and took an active part in the work of the Ohio Electric Light Association.

Abstracts of the papers and discussions will be printed in the issue of next week.

Convention of the Illinois State Electrical Association.

The seventh annual convention of the Illinois State Electrical Association, which was held at the Leland Hotel, Springfield, Ill., September 19 and 20, had the largest attendance of any of the conventions held since the organization of the association. There were in attendance 91 representatives of electric light and electric railway companies and 55 representatives of manufacturers and supply dealers. The papers presented at the meetings, which will be noticed at length next week, were particularly interesting and elicited considerable discussion.

The convention was called to order in the tea room of the Leland Hotel at 2.30 o'clock, September 19, by President David Davis, who introduced Mayor Devereux, of Springfield. Mayor Devereux in a few words welcomed the members of the convention to Springfield. He then brought up the subject of municipal ownership, saying that by the merging of public utility companies he believed these to be in a better position to give good service than could probably be given if cities operated the systems. He referred to the local company in Springfield, which controls the street railway company, the gas company and two electric light companies, saying that the citizens of Springfield were enjoying good service. He said, however, that some citizens object to walking up to an office and paying bills. These people preferred to have a gentlemanly collector come around half a dozen times and meekly ask them to pay.

President Davis, in responding to Mayor Devereux's speech of welcome, said the members intended to take advantage of the mayor's welcome and would enjoy themselves to the fullest extent while in Springfield.

The first paper on the programme was presented by W. J. Achelpohl, of Galesburg, entitled "System of Accounting for a Moderate-sized Plant," which led to an animated discussion. At the conclusion of the discussion President Davis took occasion to call the members' attention to the exhibits of the manufacturers and supply men open for inspection in the hotel. He added that he was glad to see so many representatives of supply houses present. These, he said, always helped to make such meetings pleasant. The convention was then adjourned until 2.30 o'clock in the afternoon.

The afternoon session was opened by Mr. W. G. Austin, manager of the Effingham Electric Light & Power Company, who presented a paper concerning the operating features and the cost of operation of two 120-brake-hp Diesel oil engines installed in his plant. The lengthy and interesting discussion on Mr. Austin's paper was followed by the reading of a paper by J. Robert Crouse, of Cleveland, Ohio, entitled "Profitable Commercial Co-operation." This paper was prepared for presentation at the June meeting of the National Electric Light Association at Atlantic City, and in the absence of Mr. Crouse was read by F. C. Maxheimer. The paper has already received notice in these columns. Mr. Maxheimer stated at the conclusion of the paper that it was desired that two representatives be appointed by the association to co-operate with other representatives from similar associations in providing means for carrying out the work of co-operation among the several branches of the electrical industry as outlined in Mr. Crouse's paper. President Davis said the appointments would be made at a later time.

The next paper on the programme was that of Mr. Robert W. Lamphere, of Springfield, on the general subject of electric meters. Time would not permit a discussion of Mr. Lamphere's paper and immediately before adjournment a committee on resolutions consisting of Senator Shumway, Mr. W. E. McCulloch, of Beardstown, and Mr. E. B. Hillman, of Quincy, was appointed. A nominating committee consisting of Messrs. R. S. Wallace, of Peoria; George H. Lukes, of Evanston, and R. H. Abbott, of Petersburg, was also appointed.

At 4 o'clock the convention adjourned to visit the factories of the Sangamon Electric Company and the Illinois Watch Company. Several cars, provided through the courtesy of Emil G. Schmidt, vice-president and general manager of the Springfield Heat, Light & Power Company, conveyed the party to the factories. During the remainder of the evening the members of the convention were

the guests of the Springfield Heat, Light & Power Company. After a ride over the city lines special cars conveyed the party to a park where dinner was served. On returning to the city the party was entertained by a special vaudeville entertainment.

The session on Thursday morning was opened by J. J. Frey, of Hillsboro, who submitted a report of the insurance committee, which consisted of Mr. Frey and W. A. Thomas, of Abingdon. The committee reported that after several trips to Chicago the State Board of Fire Underwriters and the governing board of the insurance companies had been prevailed upon to appoint an inspector to inspect and re-rate the plants in Illinois. As a result of inspections made a new schedule had been put into effect on several plants with a reduction of about 40 per cent in the basis rate.

In the past year 86 plants had been inspected and the new rate had been put into effect on them. On 25 companies from which reports had been obtained the amount of insurance carried was $728,700. The old premium was $10,451.93 and the new premium $9,333.86, showing a saving of $1,418.67 for 25 companies. He said the old rate on the plant of the Hillsboro Electric Light & Power Company was $1.25 on the building, which is of brick with gravel roof and the rate on the machinery was $1.50. As a result of an inspection some changes are being made which will give a new rate on the building of $0.41 and on machinery of $0.66. The saving on the insurance will be $124.50 per year and in two years this saving will pay for the improvements.

With regard to liability insurance the committee reported that it had sent circular letters to the members asking whether they would join other members and carry employers' liability insurance at not to exceed 2½ per cent and public liability insurance at not to exceed 4 per cent of the yearly pay roll. Out of 37 companies 10 reported they would do so, four would carry public liability insurance alone and two would carry only employers' liability insurance.

A second letter to which 78 replies were obtained showed that 17 companies with an annual pay roll of $277,700 paid in a period of four years $23,519 in premiums for liability insurance and sustained injuries for which $7,450 had been paid by the insurance companies. Fifty-two companies not carrying liability insurance paid out $7,966 during five years. Seven companies carrying public liability insurance had paid out in premiums in four years $6,571 and the insurance companies had paid $8,560 for injuries. The general discussion following the reports of the insurance committee showed that the members were deeply interested in the work of the committee and appreciated its efforts.

President Davis urged that reports be made to the insurance committee of all plants that had not been inspected. Wm. L. Clarke, of Paris, said his plant had been inspected and that only a few small changes were necessary in order to obtain quite a reduction in the insurance rate. Senator Shumway urged members to notify the insurance committee whenever improvements were made. Rebates on the insurance already paid would be made or new policies incorporating rebates would be issued as soon as improvements were made that lowered the rate.

With an expenditure of not more than $20 it was stated that one plant had been able to reduce its rate from $1.95 to one-third this amount. Other examples were cited showing the importance of having inspections of plants made and of following the recommendations made by the inspectors. Mr. Frey emphasized the fact that cleanliness about a plant is a point taken into consideration in making insurance rates.

Mr. McCulloch thought in view of the fact that the last legislature had raised the liability for loss of life from $5,000 to $10,000 that the question of both public and employers' liability insurance deserved more attention than before. Mr. Frey thought plants should be divided into three classes and that the rate of liability insurance on each class should differ. He thought the well-kept-up plants should be put in a class by themselves and should be given a lower rate. An intermediate class would be composed of plants reasonably well kept up. Those plants that were in a run-down condition and that were conducted in a careless manner should be charged the highest rate. He said two insurance companies had agreed to take both public and employers liability insurance on a 5 to 6 per cent basis, and they agreed further that if they made over 5 per cent they would reduce the rate. He urged that several of the plants go in together and obtain the reduced rate. Mr. Wm. L. Clarke, of Paris, said he had always carried both public and employers insurance and for a period of 10 years he received no benefit. But after that period of time one of his employes met with a fatal accident and he said it was very pleasant then to stand back and see the insurance companies fight a case for large damages.

Mr. F. J. Baker, of the North Shore Electric Company, near Chicago, said that after carrying employes' liability insurance for three or four years he had discontinued it. He did not like it because damage cases were not cleared up quickly and further there was a better feeling among the employes when it was not carried.

In further discussion the point was brought out that where companies operate 24 hours in the day the liability is six or eight times greater than when they operate only until midnight. The rates, therefore, should not be the same for all plants. Under the present plan of charging one rate for all companies the small company operating only until 12 o'clock paid more than was warranted by the hazard.

In the absence of Mr. F. W. Wilcox, of the General Electric Company, his paper, "Present Status of the Incandescent Lamp" was read by a representative. Following the presentation of this paper Mr. A. V. Schroeder, of Springfield, read a tentative outline of the tests to be conducted on Illinois coal at the University of Illinois. A paper presented by Charles E. Sharpe, of Moline, as an introduction to a general talk on points of interest on station operation led to an interesting discussion; after which the meeting adjourned with the announcement by President Davis that the association would meet in executive session in the afternoon.

The convention passed a vote of thanks to the officers and the members presenting papers and also to Mr. Emil G. Schmidt, vice-president and general manager of the Springfield Heat, Light & Power Company, and to W. B. McKinley, president, and L. E. Fischer, vice-president and general manager of the Illinois Traction System for the manner in which the members of the convention had been entertained.

Officers for the ensuing year were elected as follows:

President, Mr. J. N. C. Shumway, of Taylorsville; first vice-president, Mr. E. L. Brown, of Elmwood; second vice-president, Mr. E. McDonald, of Lincoln; third vice-president, Mr. E. H. Gray, of El Paso; fourth vice-president, Mr. O. L. Hyatt, of La Grange; treasurer, Mr. J. J. Frey, of Hillsboro. Executive Committee: Messrs. W. B. McKinley, of Champaign; Mr. E. G. Schmidt, of Springfield; F. J. Baker, of Chicago; Charles E. Sharpe, of Moline, and D. Davis, of Litchfield.

The time and place of the next meeting was left to the executive committee. The convention adjourned at 4 o'clock Thursday. The members then became the guests of the Illinois Traction System. A special buffet car conveyed the party to Riverton where the power house of the Illinois Traction System was inspected, and on returning to Springfield the special car conveyed those whose homes were in the vicinity of East St. Louis to that city.

Data of American Railroads.

The statistics just issued by the United States Interstate Commerce Commission show that on June 30, 1905, the total single-track railway mileage in the United States was 218,101, or 4,196 miles more than at the end of the previous year. The number of railway corporations for which mileage is included in the report was 2,167. The number of roads in the hands of receivers was 26.

There were in the service of the carriers 48,357 locomotives, the increase being 1,614. The number of cars was 1,842,871, or 44,310 more than for 1904. These figures do not include cars owned by private commercial firms or corporations.

The reported number of persons on the pay rolls of the railways in the United States on June 30, 1905, was 1,382,196. The total number of persons killed was 9,703 and 86,008 injured. A large number of these were trespassers on tracks or moving trains. The greatest casualties were among the railroad em-

ployes, as follows: Trainmen, 1,990 killed and 29,853 injured; switch tenders, crossing tenders and watchmen, 136 killed, 883 injured; other employes, 1,235 killed, 36,097 injured.

The par value of the amount of railway capital outstanding on the date named was $13,805,258,121. Of the total capital stock outstanding, $2,435,470,337 paid no dividends. The number of passengers carried was 738,834,667, being 23,414,985 more than in 1904. The number of tons of freight carried was 1,427,231,905, exceeding the tonnage of 1904 by 117,832,740 tons. The gross earnings from the operation of 216,973 miles of line were $2,082,482,406, or $107,308,315 greater than for 1904, and, for the first time, exceeding the two-billion mark. The operating expenses were $1,390,602,152, or $51,705,899 more than in 1904. Net earnings amounted to $691,880,254, an excess over the previous year of $55,602,416.

The amount of dividends declared during the year under review was $238,046,897, leaving as the surplus $89,043,490, as against the surplus for the preceding year of $56,729,331.

CURRENT NEWS AND NOTES.

READY IN OCTOBER.—It is stated that the electrical operation of the New York, New Haven & Hartford Railroad will begin October 31, by which time all will be in readiness between the Grand Central depot and Stamford, Conn.

WIRELESS INTERNATIONAL LAW.—The Institute of International Law, now in session at Ghent, Belgium, adopted after a discussion of the State regulation of wireless telegraphy, articles declaring that the air is free, and no State possesses rights in it except when necessary for its preservation. Every State may, however, so far as it is necessary to its safety, oppose the passage of Hertzian waves over its territory. If any government prohibits wireless correspondence it shall immediately warn the other governments.

HARVARD MEDICAL SCHOOL.—This week the new and magnificent buildings of the Harvard Medical School were dedicated. They stand on the Fenway and cost $5,000,000. This group is the largest addition, in its history, to the resources of the university, and will take care, it is said, of 600 enrolled students. The electrical equipment will go far to illustrate the use of electricity as a new adjunct in medicine and surgery, and the Röntgen ray outfit will be unusually complete, including provision for ray photography.

UNITED STATES WIRELESS PLANT.—It is reported that the work of removing all portable materials from the abandoned United States Government's wireless station at Montauk, L. I., to the new station at Fire Island, was completed this week. The apparatus was carried by boat through Shinnecock Bay and Great South Bay. The Fire Island site is one-eighth of a mile from the lighthouse. It is much superior to the Montauk plant, as the largest vessels pass within ten miles of the Atlantic shore. The new station will be completed before the cold weather.

LUMBER TESTING AT PURDUE.—A long series of experiments has recently been completed at Purdue University as to the effect of certain processes now in vogue to increase the life and physical qualities of timber. These processes are a result of the steady diminution of the timber supply and of a feeling that every possible means should be employed to increase the durability of that which is used. Especially is this true in reference to timber for manufacturing purposes, for railroad ties, telegraph, telephone and trolley poles, etc. The experiments at Purdue were made chiefly in the interest of railroads and wire companies, by making mechanical tests of ties and poles treated by different processes. Four hundred and eighty ties were used and over 6,000 tests were made. The timber testing laboratory at Purdue is the one used by the Government at the St. Louis Exposition.

COPPER AT HIGH FIGURE.—The effect of the present high price of copper on the electrical industries is being watched with serious interest. On Tuesday of this week copper metal reached its highest price in the history of the New York Metal Exchange, when Lake copper was quoted at 19.75c. to 20c. a pound. The metal has actually been selling at 20c. for immediate delivery for some time. The advance in the official quotations on Tuesday was the fourth posted on the Exchange this month. A price of 19½c. per pound was the record figure for copper from the boom times of 1899 until December of last year, when a quotation of 19¾c. was reached. At that time, as at present, small lots for immediate delivery commanded a premium, in some cases as high as 1½c. The high prices of 1899 were followed by a gradual decline which carried the metal as low as 10⅞c. in 1902. It is believed, however, by authorities that the supply is so little able to keep pace with the demand that the lower figure will probably never be seen again. Electrolytic copper follows, of course, the same advancing tendency.

TROLLEY CAR STEPS.—The exigencies of construction, in the adoption of electric motors, has driven car builders to increase the height of the car step and even add steps. The New York State Board of Railroad Commissioners have received many complaints from women in reference to the excessive height of the car steps on the street surface roads in this state. It was decided by the commission that a remedy could be more quickly obtained by a conference with the managers of the different roads than by recommendations to individual companies against whom the complaints have been received. For this reason the matter was brought to the attention of the New York State Street Railway Association, which at its last convention appointed a committee to consider the subject. This committee has reported to the association that the preferable maximum height between the top of the rail and the first step of all cars of the box type with 33-in. wheels is 18 in., with a minimum height of 14; that the maximum distance between the first step and the car platform be 15 in. with a minimum distance of 12; and that the maximum distance between the car platform and the top of the floor of the car be 10 in., with a minimum distance of 8. "It is the opinion of the committee that an ideal condition would call for a height of 17 in. from top of rail to the first step, and from the first step to the platform, 14 in., and from the platform to the floor of car, 10 in., making a total distance from top of rail to floor of car, 41 in. It is also recommended that the tread of all steps be not less than 10 in."

INTERESTS IN CUBA.—The troubles in Cuba direct attention to American interests there. The electrical ones are quite considerable, not including the cables that land on Cuban shores. Mr. Atherton Brownell, in *Appleton's Magazine,* makes a survey of the situation. In electric transportation in Cuba Americans are practically monopolists. With a single small exception the entire street car service of Havana is rendered by the Havana Electric Railway Company, also a New Jersey corporation, which has fifty-three miles of trackage constructed under military supervision during the intervention period. Although a separate company, the Havana Central should be included, since its operation will cover 120 miles of territory outside of Havana. American capital likewise controls the telegraph and telephone systems of Cuba. The Red Telefonica passed into the hands of an American corporation about four years ago on the investment of $550,000. This concession soon terminates and then it will be absorbed in the Cuba Telegraph & Telephone Company, an American corporation, and which has thus far demanded an investment of $1,500,000. In connection with this should be noted the Havana Subway Company, an American corporation, which was granted a right to construct a subway in Havana for the purpose of carrying all electric wires. This latter company has $1,000,000 for construction purposes and a concession which gives to it a monopoly of all electric wires in Havana for a considerable number of years. The American investment in Cuba up to date in telephones and telegraphs is $2,550,000. The electric lighting plants of the island are largely of American origin or ownership. The total American investment in the island is placed at $150,000,000.

ELECTROLYTIC COPPER.—It is stated that the 1906 production of electrolytic copper will be about 800 million pounds, worth in the neighborhood of $150,000,000.

CABLES TO ICELAND.—Cablegrams may now be sent to Iceland, the cost being 15 cents a word from England. The Icelandic land lines, which will connect Seydisfjord, the cable point on the east coast, with all the principal towns, including the capital, Reykjavik, will also be completed by October 1.

WHAT GOOD SERVICE MEANS.—Speaking of the purchase of 200 cars at a cost of $1,000,000, James H. Eckels, receiver of Chicago Union Traction, says: "We will greatly improve the service, believing that by so doing we shall kill any sentiment that may exist among the people for municipal ownership. The people do not want municipal ownership."

PUBLIC UTILITIES.—Governor Stokes, of New Jersey, has appointed Messrs. James H. McGraw, of Madison, A. B. Leach, of South Orange, and Assemblyman Alfred N. Barber, of Trenton, members of the commission provided for by the last Legislature to investigate the feasibility of a law providing for a division of profits of public utility corporations between such companies and the municipalities in which the utilities are operated.

THE OSMIN LAMP.—A special cable message from Europe states that the Osmium Licht Unternehmung in Vienna has been absorbed by the European Westinghouse Company. The first-named corporation has recently come into prominence as the manufacturer of the tungsten lamp sold in Europe under the name of the "Osmin." This important transaction was intimated in these pages two weeks ago.

BERLIN-ST. PETERSBURG WIRELESS.—Reports are made from Russia of successful experiments in wireless telegraphy between there and Nauen, near Berlin. Messages have been correctly transmitted for a distance of 800 miles, 600 miles being overland. If this line proves practicable it will replace the relay wireless systems by Gulf and Baltic ports to Stettin, which was installed after the October strike to prevent another total interruption in communication abroad.

THE NEW ROCHELLE ACCIDENT.—A few weeks ago, a number of boys at New Rochelle, N. Y., started an amateur telephone system at Rochelle Park, and undertook to put their wires on a joint pole line occupied by and belonging to the New York Telephone Company and the Westchester Lighting Company. As a result, an accident happened, and one of the boys was killed. It was stated at the time that these youths had obtained permission to string the wires on the pole line, but, it appears that as a matter of fact, and as might be expected, this work was done without the knowledge or consent of either company; and this fact was made clear at the coroner's inquest.

AMERICAN CIVIC ASSOCIATION.—The annual meeting of this body is to be held at Milwaukee on October 24, 25 and 26, at which time President J. H. McFarland will deliver an address on the Niagara campaign, which the body carried on for the "preservation" of the falls, and to which, in part, was due the national legislation restricting use of water. The bulletin of the association contains one story from Mrs. C. B. Crane, of the advisory committee, who tells of the improvements effected in village improvement, as at Comstock, Mich., where electric lamps were placed in the center of the town and oil lamps at other points. "All these things were planned at our banquets in the winter, when money was raised for the street lights."

INDEPENDENT TELEPHONE GROWTH.—Charles S. Norton, secretary of the Indiana Telephone Association, has gathered and compiled some data covering the growth of the independent telephone movement in this country during the past eight years. According to his figures there was a daily average of $100,000 of capital invested in such telephone property; 1,200 subscribers secured; three companies incorporated; 200 miles of metallic toll lines constructed; 120 new stockholders secured. This means that for the eight years last past the independents have built and equipped complete each day thereof an average exchange of 1,200 subscribers with complement of 200 current miles of toll lines. Mr. Norton thinks few other businesses can show as good record.

THE PEABODY (MASS.) PLANT.—An interesting report has been filed on the Peabody municipal plant by the Electrical Auditing Company, of Boston. The report shows that the plant could buy electricity from at least three private systems cheaper than it can manufacture for itself, and recommends that service be taken from the Salem Electric Light Company at a price of 2½ cents from 4 to 10 p.m. and 2 cents from 10 p.m. to 3 p.m. The report recommends also the sale of a lot of the old machinery and equipment; a development of the sale of electrical energy for power purposes, and a change of business methods. The report remarks: "It is a curious and rather interesting fact that for some reason municipal plants as a whole consider it as entirely unnecessary to canvass or otherwise attempt to obtain new customers or add to the connected load of their existing customers. This is probably due to the fact that the municipal plant in most cases absolutely controls the territory and has no existing competition. If, however, there were competition in the same town, even admitting the loads to be identical, it is unquestionably a fact that in nine cases out of ten the municipal plant would go to the wall, if it did not make some effort to canvass and obtain customers. The canvass should be steady and systematic and it has been clearly shown by private corporations that no matter what the connected load or conditions may be, it is always possible to increase business by going out after it. How few business firms to-day could afford to sit down and wait for the business to come to them. The customers that come unsolicited to a plant are those that are practically driven to it by their necessity. There remains always in any town a large number who need to have the advantages pointed out to them. This is particularly so in power service."

DENUDING THE NORTH WOODS.—A newspaper correspondent, writing from Little Falls, says of the effect of forest destruction in the Adirondacks: "Prolonged dry weather has reduced the volume of water flowing out of the Adirondacks to a point lower than has been known in years, if ever. The West Canada Creek, which is the main feeder of the Mohawk River, can be crossed at Northwood dry shod. Fifteen years ago this was impossible. The power companies at Trenton Falls, Dolgeville and Glens Falls have been able to produce only two-thirds as much power as their nominal capacity calls for, owing to the lack of water volume to turn the turbines. A trip of eighty miles through the West Canada watershed disclosed a noteworthy condition of affairs. Practically every rivulet in the woods shows the effect of the prolonged dry weather, and lack of evergreen trees to shade the land. Guides who came up Indian River from Moose River last week said that they had never seen that stream so low before. Hundreds of tiny threads of water which formerly fed the brooks and rivers have dried up, and their beds disclose alternate pebbly and scarcely moist bottoms of pools. The lakes themselves show the lack of water, for around the shores are signs indicating a fall of several inches from the normal level. The outlets of the lakes are, of course, very low. Perhaps the most remarkable fact about the denuding of the mountains is the failure of the public to notice it. Although floods traceable directly to the cutting of the timber have resulted time and again, yet no effort worthy of the name was made to check the cutting away of the natural reservoir system. If the pulp and lumber companies had started to draw the water of streams off into other courses, countless lawsuits would have been instituted and won. A case to the point is that of the villages of Herkimer, Middleville, Newport and Poland, which are combating the effort of the Utica Water Company to take a pipeful of water from the West Canada to that city's water system. These same villages have never uttered the slightest protest against the logging companies which made the present low water conditions possible."

THE CALL OF THE WILD.—Discussing the impatience of some people at the telephone the *New York Tribune* remarks: "A great many of those who are returning from the woods and the seacoast assert with great satisfaction that they have been for weeks 'out of the reach of the telephone and the telegraph and the daily paper.' But let these same men and women fail to connect with the telephone in at least two minutes; let them wait beyond what they deem ample time for an expected dispatch, or let their paper be delayed for, say, fifteen minutes, and what a row they make!"

PROFITS FOR EMPLOYEES.—The directors of the Boston Consolidated Gas Company have announced the putting into effect of their experimental plan of sharing profits with its employees to take effect at once. Only those employees who, in the judgment of the directors are temperate, honest, capable and efficient are to be included as profit sharers. The first dividend will be at the rate of 7 per cent on the salaries or earnings for the nine months ending June 30, 1907. The money is to be applied toward the purchase of preferred stock in the Massachusetts Gas Companies, the stock to be absolutely the property of the employees.

N. E. L. A. QUESTION BOX.—Secretary Eglin announces that Mr. Paul Lüpke has accepted President Williams' invitation to serve again as editor of the *Question Box* of the National Electric Light Association and has already begun the preliminary work. Mr. Lüpke's work in this department of the Atlantic City programme was most excellent—especially when it is considered that he was asked to undertake the work but a short time before the convention. With the experience gained and opportunity now given for more leisurely and careful editing, there is every reason to belive that the 1907 *Question Box* will be far in advance of its predecessors. A great deal of valuable and useful information is collected by this means from electrical engineers and central station managers and made generally available to the profession.

ELECTRICITY ON GEORGIAN BAY.—Advices from Ottaway, Ont., state that the report of the engineer in charge of the Georgian Bay canal survey, to be presented to the Dominion Parliament at the approaching session in November, will show the feasibility of a hydro-electric development of 1,250,000 hp along the route. It is considered that an expenditure of $100,000,000 would be justified for the increased facilities afforded for the transportation of the products of the western wheat fields to the Atlantic seaboard by this proposed great waterway. But if, in addition, this great electric development can be realized, there would be a much stronger incentive for proceeding with the work as a national undertaking. Electricity would not only be utilized for the varied uses of commerce, but also for the mineral wealth contiguous to the river, so that a great development could be carried on of the immense fields of iron deposits along the route of the canal.

FAIRBANKS ON OWNERSHIP.—In a speech which Vice-President Fairbanks delivered last week at the laying of the cornerstone of Chicago's new county building, he discussed National and State ownership of the railroads, saying: "Those who advocate the ownership of the railways of the country by the Federal Government or by the Federal Government and the State Governments propose a radical departure from the sound principles which have hitherto guided us. They propose to introduce the Government into a field which is possessed by individual and corporate enterprise—a field which the latter are fully competent to occupy. This departure would be a long step toward dangerous centralization of power and toward the inauguration of a system of socialism, which is the substitution of the Government for the individual. It is not wise policy for the State to usurp functions which can be readily discharged by the people in their individual or corporate capacity."

STREET RAILWAY CONVENTION.—The customary reduced rates of fare and one-third for the round trip have been granted by the various railroad companies for the twenty-fifth annual convention of the American Street and Interurban Railway Association, to be held at Columbus, Ohio, October 15-19, 1906. This rate is on the usual certificate plan. The tickets will be sold and certificate issued October 11 and 17, and tickets for the return trip will be good until October 23. Pullman accommodations will be at the regular rates. For the accommodation of the Eastern delegation and representatives arrangements have been made to run a special train over the New York Central lines, consisting of baggage, buffet, library, smoking car, with barber and bath, Pullman open section, compartment drawing-room, observation cars of the latest design, together with two dining-cars, and will be in charge of the traveling passenger agent. The train will leave New York at 2.04 p.m. Sunday, October 14; Boston at 10.45 a.m., and Albany at 5.08 p.m., arriving in Columbus at 6.58 a.m., Monday, over the Big Four route. Applications for reservations should be made to Mr. Milton C. Roach, at 1216 Broadway, New York City, and Mr. R. M. Harris, 366 Washington Street, Boston.

SOUTH AMERICAN RELATIONSHIPS is the theme of an interesting report to the United States Department of Commerce and Labor by Mr. John Barrett, American minister to Colombia. The following is his summary of the specific agencies to be employed and developed in securing closer commercial and friendly relationships with South America: "1. The sending of business representatives or traveling salesmen, who should always be gentlemanly and speak Spanish and French. 2. The manufacture in the United States or adaptation of articles to suit the local Latin-American demand. 3. The giving of credit to reliable purchasers, as is done by European shippers, instead of always exacting payment in advance or on shipping. 4. The use of greater care in packing goods for the long distance of travel and for the severeness of climate, and for the size of parcels required in different markets. 5. The opening of North American banks or branches thereof in the principal cities of South America. 6. The inducing of young Latin-Americans to come to our technical and professional schools instead of going to those of Europe. 7. The popularization in our schools and colleges of the study of Latin languages, history and institutions. 8. The early building of Pan-American railway connections so that North, Central and South America may be literally united with ties of steel. 9. The investment of North American capital in developing resources, mines and industries and in the construction of railways, tramways and electric light plants in the more progressive countries of South America."

EQUIPMENT FOR THE HUDSON TUNNELS.—The twin tunnels of the Hudson Company, connecting Jersey City with New York under the North River, represent the most recent development in electrical projects centering about New York City. Construction work on these tunnels was finished about a year ago and work on the electrification will begin at once. Fifty electric cars will be operated, taking their power from the third rail. Each tunnel will have a single track; the north tube carrying the west bound traffic and the south tube carrying the east bound or New York traffic. The cars will be operated in trains by multiple-unit control. Each car will be equipped with two 160 hp railway motors. Power for this new development will be supplied from a large station on the New Jersey side, located between Jersey City and Newark. Curtis steam turbines will be employed; the initial equipments including two 3,000 kw, 11,000 volt machines and two 6,000 kw, 11,000 volt machines. All this apparatus will be supplied by the General Electric Company. The total power so generated will be distributed at high voltage to three sub-stations where the alternating current will be stepped down to 650 volts direct current through transformers and rotary converters. These sub-stations will be located as follows: Sub-station No. 1, Greenwich and Christopher Streets, New York, containing five 1,500 kw rotary converters and 15 step-down transformers; sub-station No. 2, Washington and First Streets, Jersey City, containing four 1,500 kw rotary converters and 12 step-down transformers, and Sub-station No. 3. Cortlandt and Church Streets, New York City, containing two 1,500 kw rotary converters and six step-down transformers. Each sub-station will, in addition, contain one spare 1,500 kw transformer. It is expected that when the new lines are in operation, the running time between the various suburban cities of New Jersey and New York City will be reduced one-half.

Port Morris Power Station of the New York Central & Hudson River Railroad.

During the latter part of October, or early in November, the New York Central & Hudson River Railroad Company will make the anticipated change in its motove power from steam to electricity in the initial electric zone south of High Bridge and Wakefield. The work incident to this change has progressed to such a point that were it not for new signals and the abnormal passenger traffic in the early autumn, the change, so far as motive power is concerned, could be made early in October. The electricity to operate the cars and locomotives will be generated in two power stations; one at Yonkers on the Hudson River, and the other at Port Morris on Long Island Sound. These two stations have capacity enough and to spare for the ultimate electric zone, which will extend to Peekskill on the Hudson division, and to North White Plains on the Harlem division. The Port Morris station is now in operation, but the Yonkers station will not be completed for some months. The power station at Port Morris, however, has ample capacity to operate the initial electric zone and the four sub-stations for this zone are practically in readiness so that electric service by the time specified is assured.

The Port Morris and Yonkers stations will be almost duplicates, and although they embody no radical departure from recognized practice, each is an excellent example of modern engineering. The station sites besides being near the load centers of the electric traction system are at once adjacent to navigable waters and existing railroad tracks, so that an unlimited supply of circulating water is available, and shipments of coal may be received by rail or by water. Provision is made at each station for an ultimate capacity of 30,000 kilowatts, which is sufficient to operate a train service much greater than that now operated by means of steam locomotives.

The station building at Port Morris is a brick and steel structure with concrete foundations extending down to bed rock. Every precaution has been taken to eliminate fire risks, and not a little attention has been given to the illumination of the interior. As shown in the sectional elevation herewith, the building is divided longitudinally by a brick wall, into boiler and generator rooms. The latter room extends clear to the roof, and what with windows on all sides and skylights in the monitor, this room is exceptionally well lighted. The boiler-room, being surmounted by the coal bunkers, and the boilers being arranged along both sides of the room, there is little chance for much natural illumination. Moreover, the black surface of all the apparatus is not conducive to good artificial illumination. On the north side of the generator room are three galleries; the first gallery is occupied by a machine shop and a few offices; the second contains the operating switchboards, and the top gallery is given over exclusively to offices. The boiler-room is also provided with galleries and runways for convenient access to all parts of the piping and apparatus.

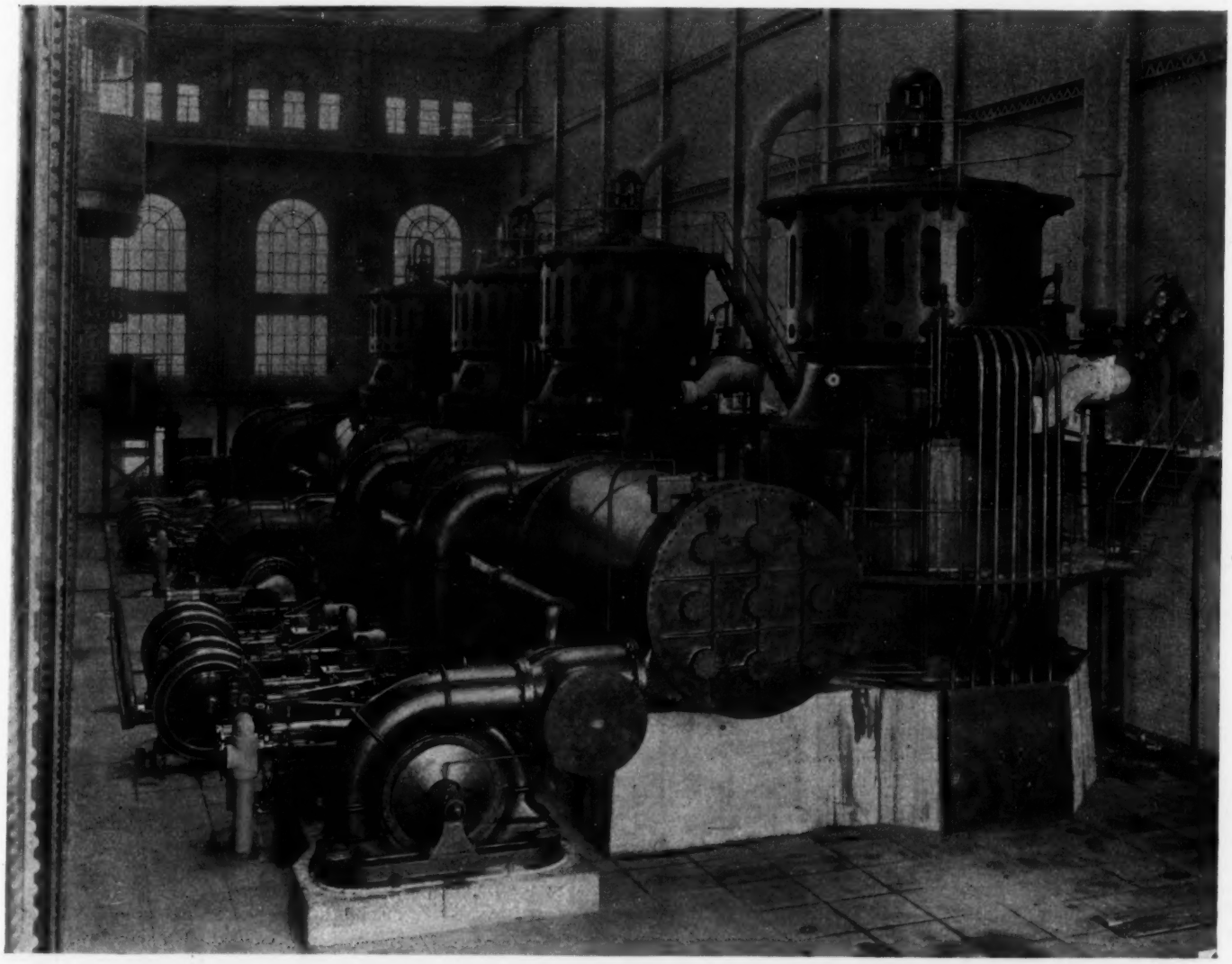


FIG. 1.—GENERATOR ROOM, PORT MORRIS POWER STATION OF THE NEW YORK CENTRAL RAILROAD.

The present steam generating equipment comprises 16 Babcock & Wilcox boilers, and space is available for eight more. Each boiler has 6,250 square feet of heating surface and 112 square feet of grate surface, giving 10 square feet of heating surface per rated horse-power and a ratio of 55.8 to 1 between the heating and grate surface. A total superheating surface of 1,230 square feet is provided in each boiler, in which the steam is superheated 200° F. above the temperature due to the pressure.

The rated working steam pressure is 185 pounds, and the maximum steam pressure is 200 pounds. The boilers are rated at 625 hp each and are arranged eight on each side of a central alley. Roney stokers are fitted to all the boilers, and the fuel used is Clearfield bituminous coal. The second pass of each boiler is provided with a soot chute discharging into the ash hopper below the boiler, and the rear of the setting is connected to an outboard drain to carry off the washing-out water. Two radial brick stacks carry off the products of combustion. These are supported on steel columns and a reinforced concrete staging 40 feet above the boiler-room floor, and directly over the boiler-room alley. The chimney has an internal diameter of 15½ feet and is 250 feet high above the grates. The flues are of steel, lined with fire brick and tile and are designed to give a natural draft of not less than 0.7 inch water pressure at the smoke flues.

Coal is at present being brought by rail, the slip at the south side of the station by means of which coal barges may moor alongside the hoisting tower not being completed as yet. The coal cars ascend the trestle on the south side of the station and dump their load into concrete-lined hoppers which discharge into hoppers of two coal crushers. From the crushers the coal is fed to an elevating conveyor of the bucket type, which carries it to a point over the bunkers, whence it is distributed by four suspended-flight scraper conveyors operating independently. Coal delivered by boat will be elevated by means of a hoisting tower to a hopper over the car tracks, and from here it will follow the course of the coal delivered by rail. With the exception of the hoist which is used to unload the boats, the coal and ash-handling machinery is driven by electric motors, ranging in size from 7½ hp for the ash conveyor to 40 hp for the coal crushers and conveyors. The motors are of the three-phase induction type and operate at a potential of 220 volts. From the coal bunkers the coal is discharged to the hoppers of the stokers through cast-iron chutes and distributing aprons. The ashes fall from the grates to hoppers below, which discharge into hand push cars of one ton capacity. These dump their load into conveyor hoppers in the basement beneath the boiler-room, and the ashes are carried up by a malleable iron bucket conveyor to storage bins over the trestle whence they are loaded into cars.

The apparatus in the station is divided into groups. Each generating unit is provided with four boilers, one feed pump and feed-water heater and a complete condensing plant. The feed pumps are of the Epping-Carpenter duplex, outside-packed plunger type designed for hot water and capable of feeding eight boilers. Each pump delivers through a Wainwright corrugated tube closed heater of counter-current design. The plan of steam piping is quite simple. Expansion is provided for in all places by long bends, no packed expansion joints being employed. The turbines are connected in pairs by 14-in. loops and each turbine may take steam from either of two banks of four boilers each. The auxiliaries are fed with steam taken from the cross-connecting bends between adjacent turbines. Each turbine is provided with a short free exhaust pipe which is independent of the exhausts of the auxiliaries except through the heater vents and emergency connections. The high-pressure steam piping is of mild steel with Van Stone joints and the feed and blow-off piping is of heavy cast-iron. The main cut-off valves of the turbines are operated from the floor by means of gears and shafting, the operating shaft having a hand-wheel on the boiler-room side of the wall as well.

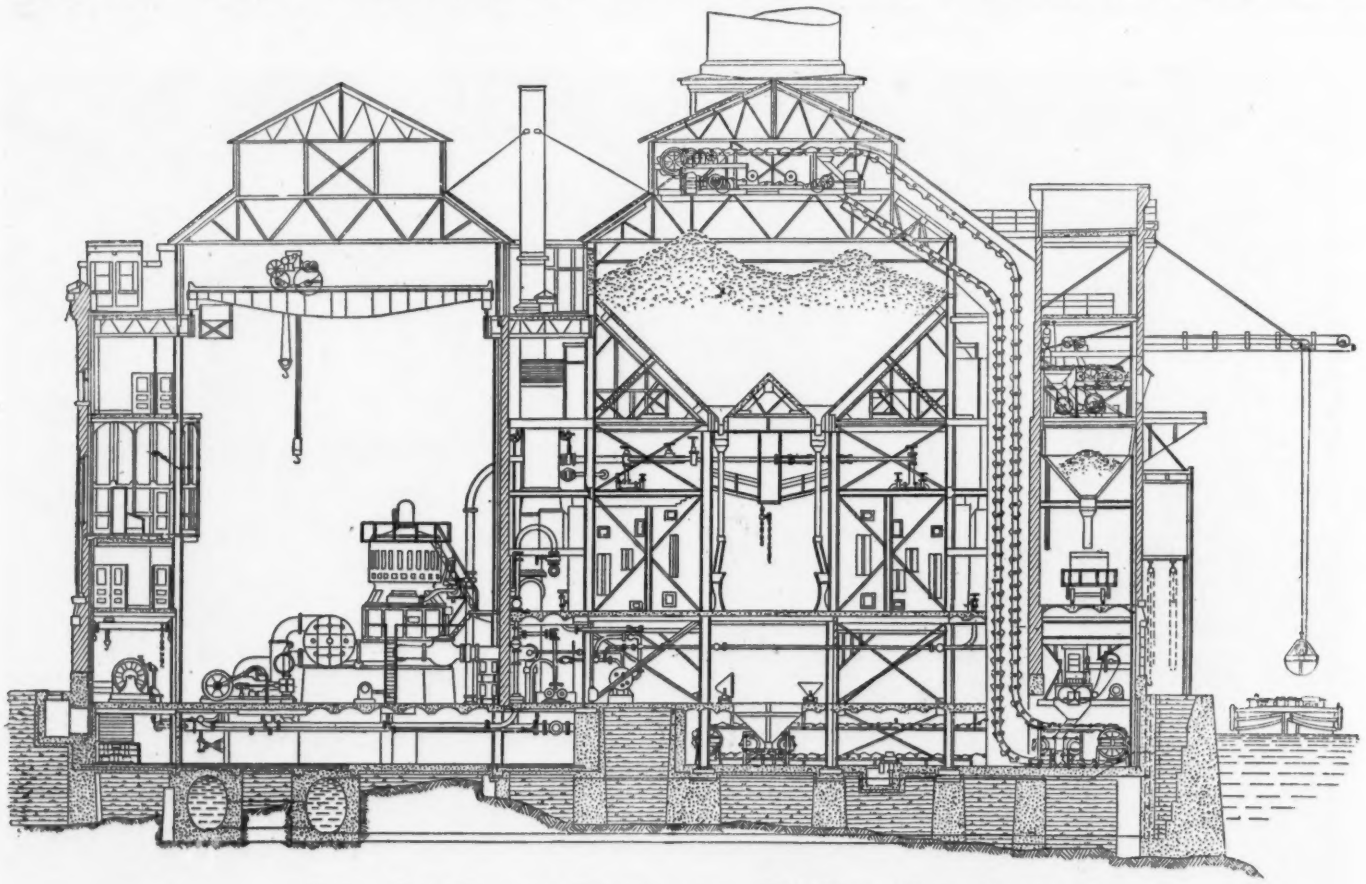


Fig. 2.—Cross-Sectional Elevation of the Port Morris Power Station.

The generating room is at present equipped with four 5,000-kw General Electric turbo-alternators, reserve space sufficient for two more units of the same size being provided. The turbines are Curtis five-stage machines mounted on cast-iron bases forming exhaust chambers which are provided with condenser openings and free-exhaust connections. The alternator and turbine are connected together by a coupling. The shaft rests upon a step bearing consisting of two cast-iron blocks between which water is forced under a pressure of 800 pounds per square inch. The piping for this system is in duplicate and is fed by three pressure pumps in addition to two accumulators, each of which is normally supplied by a large steam pump. The turbines are governed by successive openings and closings of automatic valves operated by hydraulic pressure controlled by a cam shaft. The valves deliver steam to two sets of nozzles. Should the turbines speed up abnormally, an automatic speed limiting device with which each unit is equipped, trips the main steam valve, thus cutting off the supply of steam and causing the turbine to stop.

As shown in the leading engraving, the condenser equipment

which is of Worthington make is external to the base of the turbines. The condensers are of the counter-current surface type and have 17,000 square feet of cooling surface. They are guaranteed to maintain a vacuum of 28 inches with cooling water at 70° F., and with a barometric pressure of 30 inches. The condenser auxiliary apparatus is composed of independent units. The air pumps are of the standard Worthington rotative fly-wheel type with air and steam cylinders arranged in tandem on a common base. The pump is double acting and the steam end is equipped with a variable cut-off valve gear and guaranteed to show an economy of 35 to 40 pounds of steam per hour per horse-power. The circulating water pumps are of the centrifugal type and are driven by Fleming side-crank engines at 250 r.p.m. The hot-well pumps are of the two stage turbine type, direct driven by 10-hp, 125-volt, direct-current motors. The intake and discharge tunnels for the condensers are elliptical in shape 7 ft. 3⅞ in. and 9 ft. 11 in., respectively, across the minor and major axes. These rest on solid rock and extend into the salt waters of the Sound.

The alternators are of the revolving field type, delivering three-phase current at 25 cycles and 11,000 volts. The armatures are star connected and the neutrals are grounded through individual cast-iron grid resistances connected to a common ground bus, limiting the ground current under all conditions to the amount necessary to operate the overload relays on the line switches. The guaranteed efficiency of the alternators is 96 per cent at full load. Each alternator is designed for a 50 per cent overload for two hours and a momentary overload of 100 per cent. The efficiency at one-quarter load is guaranteed to be 90 per cent. The leads from the alternators are brought down to the floor through brass pipe to the ducts leading to the high-tension switches, the arrangement being such that no high-tension conductors are exposed in the generator room.

The exciter system comprises two 150-kw horizontal steam turbine generator sets, running non-condensing under a steam pressure of 175 pounds and delivering 1,200 amperes of current at 125 volts. Floating on the system is a battery of 74 cells with a capacity of 1,200 amperes for one hour. There is an addi-

FIG. 3.—BOILER ROOM, PORT MORRIS POWER STATION.

tional exciter consisting of an induction-motor generator set running at 500 r.p.m. and delivering 1,200 ampers of direct current at 125 volts. The induction motor is a 25-cycle machine of 200-hp capacity taking current at 200 volts. The motor is started by a special switch which puts the transformer windings first in delta, then in star connection. The exciter generators and battery are connected to two independent positive bus-bars and one common negative bus. Two end cell switches are provided on the positive side of the battery. One positive bus is used to excite the fields of the turbo-alternators, while the arc lamps and direct current motors in the station are connected to the other positive bus.

The entire electrical equipment in the station is controlled from the switchboard gallery on one side of the generator room. Enclosed in a glass booth in the center of the gallery is the operating bench board on either side of which are separate

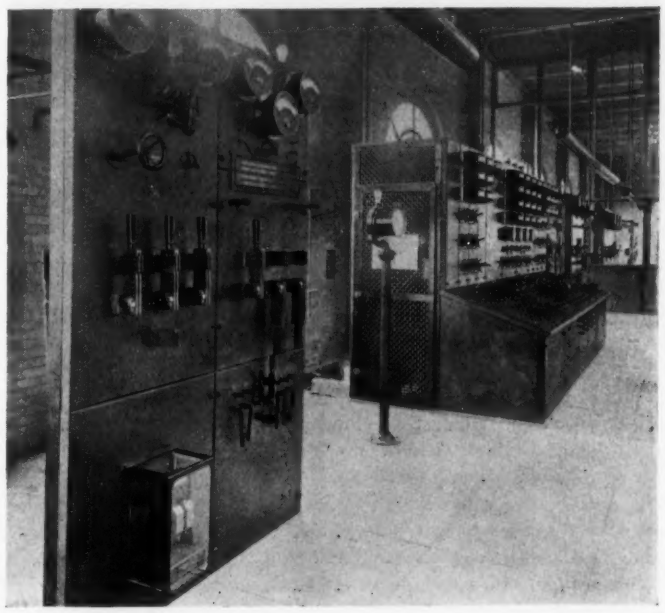


FIG. 4.—REMOTE-CONTROL SWITCHBOARD, PORT MORRIS POWER STATION.

boards for controlling the exciters. The lamp and motor circuits in the station are controlled from smaller switchboards situated at either end of the operating gallery, and the field panels are located outside of the operating booth on each side. All cables and connections running to the boards are carried in concrete trenches under a stone floor.

Separated from the main station is a switch house containing all the high-tension switching apparatus. In the basement of this building which is 50 ft. 10 in. wide and 100 ft. long, are located all the high-tension connections, instrument transformers, cables, manholes, etc. These are placed in separate fireproof compartments corresponding to the several generating units. Reinforced concrete, vitrified brick and stone are used for barriers and bus-bar compartments, and each leg of the feeder circuit is isolated until the three meet at the switch. Two sets of high-tension bus-bars are provided, each of which is sub-divided into two and three sections by tie switches. The connections to the bus-bars and oil switches are made with ¼-in. copper tubing flattened at the ends so as to reduce to a minimum the number of insulators. The high-tension bus-bars are connected to the generators through a main switch and two selector switches. Each feeder is provided with two selector switches which connect to the two respective high-tension bus-bars below them. Overload relays are connected in the generator and feeder circuits and the former has in addition reverse-current relays connected to indicating lamps.

On the first floor of the switchhouse are located all the oil switches, divided into unit groups. For each pair of groups, there is an auxiliary operating board and instrument board, the latter being equipped with instruments not essential for the switchboard operator, but necessary for the complete equipment of the station. The switchboard equipment in the switchhouse is such that the main operating board in the station may be put out of service for cleaning or repairs, the entire electrical equipment being then controlled from the switchhouse. The entire electrical control apparatus is of General Electric make. The oil switches are type "H" and the knife switches which disconnect these from the high-tension system are located in compartments at the bottom of the switch casings, one in each side.

The alternator leads, which are isolated from one another their entire length and from the low-tension cables, are brought over to the switchhouse through underground conduit lines. The same is true for all other cables running between the switchhouse and the station, so that any damage from short-circuits or burn outs is necessarily confined to the duct in which it occurs. All cables coming through the duct system enter manholes in the basement of the switchhouse. The low-tension cables enter through manholes in a passage separated from the high-tension compartments by a fireproof wall, and are brought up in enclosed chases in the wall. The oil switches have a rated capacity of 500 amperes with the exception of the tie switches which have a rated capacity of 1,200 amperes. On the same floor are installed two three-phase transformers, each having a rated capacity of 200 kilowatts, and giving 220 volts at the terminals of the secondary. One transformer is used for the general lighting and motor equipment, while the other is used to supply the induction-motor generator set in the turbine room.

On the second floor of the switchhouse are located the load despatcher's office, the exciter battery with booster and switchboard, store room, toilet rooms and apparatus for heating and ventilating system. The load despatcher's office is arranged for the proper distribution of electricity over the system, and in order to give quick relief in case of accident or trouble. The office is equipped with a record board, indicating by means of lamps and plugs which generators, lines, rotaries, etc., are in or out of service and which switches are open or closed. An independent telephone system, exclusively for the use of the load despatcher, interconnects both power stations, all the sub-stations and the train despatchers in the electric zone.

The high-tension cables and the majority of the single-conductor, low-tension cables are cambric-insulated and lead-covered. The insulation is 10/32 in. for the high-tension cables and 4/32 in. for the low-tension cables, with a lead cover 3/32 in. thick. Multiple-conductor cables for instruments and control wiring have a combined cambric and rubber insulation. Single-conductor cables are used for connecting the generators with the oil switches. Provision has been made in the station for fifteen feeders.

Alternating and direct current is used for lamps and motors, the former being three-phase at 220 volts and the latter being at a potential of 125 volts. With a few exceptions all the incandescent lamps in the station, about 1,000 in number, will be fed with alternating current, although the lamp circuits are arranged so that they can be thrown on the exciter bus-bars should occasion require it. The thirty-six arc lamps in the station and on ornamental posts outside the station are fed from the exciter circuits, as are also the crane and elevator motors and a few others. The greater part of the motor load is carried by three-phase motors. The amount of power required to operate auxiliary machinery in the Port Morris station is approximately 430 hp, of which 250 hp is supplied by alternating-current motors and 180 hp by direct-current motors. Compressed air is used in the station and switch house for cleaning the electrical machinery and apparatus. This is supplied by induction motor driven two-stage compressors delivering air at a pressure of about 100 lb.

The Port Morris and the Yonkers power stations will be tied together, so that in the event of any part of the generating equipment of one station being disabled the other station will assist in carrying the load. The transmission lines from the Port Morris station are partly underground and partly overhead. Eight sub-stations will be eventually equipped, any one of which may be fed from either generating station. The circuits are so disposed that no ordinary accident can cut off a sub-station from its source of supply. The overhead transmission lines are supported by latticed steel poles set in concrete foundations and the conductors are either 0000 bare stranded wire cable or of aluminum stranded cables spaced 36 in. apart on yellow pine cross arms. All the overhead lines are protected by lightning arresters. At points where the lines change from overhead to underground, cable towers of pleasing architectural design are provided to enclose the connections. Lightning arresters and disconnecting switches are also provided in these towers. The underground cables have three conductors of 0000 stranded copper, with paper insulation and lead sheathing. The duct lines are of vitrified tile covered with waterproofing and laid in concrete. The manholes are designed with regard to the best manner of handling and supporting the cables. Each cable lies on a removable shelving of concrete supported on iron pins. Through the Park Avenue tunnel and along the viaduct, the conductors are carried in 3½-in. steel pipes supported by brackets. The sub-station equipment will be described in a subsequent issue.

The Newton-Boston Edison Sub-station.

One of the most attractive electric lighting sub-stations in Eastern Massachusetts was recently placed in operation by the Newton & Watertown Gas Light Company at Homer Street, Newtonville, close by the Commonwealth Avenue boulevard. The Newton company is closely affiliated with the Edison Electric Illuminating Company, of Boston, and from an operating standpoint the new sub-station is known as station No. 17 of the Boston Edison system. In harmony with the Edison Company's well-known policy of extending its power supply far into the Boston suburbs and distributing it from local centers in place of generating current in inefficient and frequently obsolete local stations, it was decided by the interests concerned to substitute Edison power in Newton and Watertown, replacing the old Watertown station of the local organization by a new sub-station which should be primarily supplied from the main generating plant of the Edison system at South Boston. As the Homer Street installation stands completed to-day, it represents the most advanced suburban sub-station practice which the writer has encountered.

The architectural beauty of the building compares favorably with such structures as the Metropolitan pumping station at Chestnut Hill, Mass., and the external design is a fitting recognition of the character of the territory supplied. The Newtons have long been celebrated among Boston suburbs as a most attractive residential district, and together with the adjoining community of

FIG. I.—VIEW OF EXTERIOR OF NEWTON SUB-STATION.

Watertown, they represent a population of about 50,000. In establishing a modern engineering structure in a residential community of the first order, æsthetics play a more prominent part than in less attractive localities; hence the Newton sub-station was particularly designed to prove that utility and artistic construction need in no sense be separated in a building for electrical supply. The architects were Messrs. Winslow & Bigelow, of Boston.

The sub-station building is a concrete structure, 47 ft. by 42 ft., with brick trimmings and a cinder concrete roof surmounted by red Spanish tile. It is surrounded by a lawn with driveway and graveled walks. The walls are laid up with an outside section 4 in. thick, a 2-in. hollow tile, and then an inside wall 6 in. thick. The outside surface has a "spatter" finish, and the inside, smooth plaster finish. The doors are of ornamental design and a plaster cove with raised leaf figures is built in below the roof border. The thresholds are of pink Milford granite, and the floor is of concrete, 18 in. thick, with a granolithic surface. The foundations are of Atlas cement concrete in the proportion of 1 : 3 : 6.

In point of capacity the station is of very moderate size, its chief interest aside from architectural features being the progressiveness of its design. The interior consists of a single operating room 17 ft. 3 in. high in the clear, 40 ft. wide and 45 ft. long. There is no basement, but a pit 16 ft. 6 in. by 8 ft. 3 in. was built beneath the transformer units. In one corner of the operating room is a lavatory about 6 ft. by 5 ft., fitted with open plumbing and the most modern washing facilities. One corner is used as a telephone booth and besides the lavatory is a row of four ash lockers, 17 in. by 15 in. each. In the winter the building is to be heated by electricity, outlets for this purpose being installed at convenient points. The lighting is effected by clusters of six 16-cp, 110-volt incandescents, and during the daytime a skylight supplements the windows and door openings, giving an admirable natural illumination.

The main current supply of the Newton sub-station is derived from a 6,900-volt line, which begins at the L Street station in South Boston, and which passes from underground to overhead construction near the junction of Commonwealth Avenue and Beacon Street, in the Back Bay district. From L Street to sub-station No. 17 in Newtonville the distance is about 9 miles. The overhead line follows the Commonwealth Avenue boulevard practically all the way to the sub-station, with the exception of about a quarter of a mile of underground cable between the junction of Walnut Street and Commonwealth Avenue and the sub-station. The line consists of two three-phase circuits of No. 0 equivalent, aluminum cable, carried in triangular spacing on two cross arms at the top of the pole. The pole line occupies the center of the reserved right of way of the double-track trolley route connecting Boston with the Reservoir district and Auburndale, the trolley copper and feeders also being carried on the same poles as the Edison 6,900-volt circuits. At Walnut Street, Newtonville, four special poles are necessary to carry the circuits underground. The first pole west of the last standard pole of the line carries a large lightning arrester box and plant from below the 6,900-volt cross arms. One of the three-phase lines is tapped off at this point, a ground connection on the earth side of the arrester bank being carried down the pole in a wire which is run in a wooden sheath for the last 7 ft. of its course, to prevent accidental contact by anyone standing on the ground. As straight runs as possible are made in the 6,900-volt taps, right-angled turns, instead of bends,

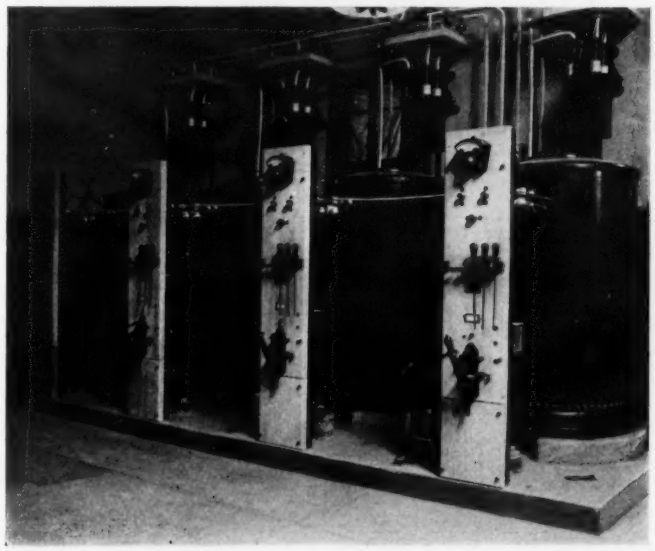


FIG. 2.—CONSTANT-CURRENT TRANSFORMER, NEWTON SUB-STATION.

being used. Porcelain bushings are installed at the entrance of the three-phase taps and the exit of the ground wire. The ground wire is also used in common with the lightning arresters of the trolley circuits. The next pole repeats this special construction for the other three-phase circuit carried in the line.

The third special pole carries a double cross arm at the top. On one side of the pole center the three cables of one line are dead-ended, and taps carried downward into a box containing an underground cable pot head, whence a triple conductor, lead-covered cable is carried down the pole and into the conduits leading to the sub-station. The fourth pole receives the other line from the third pole, dead-ends it, and carries three cable taps to a pot head as in the case of the pole just preceding. For about 12 ft. above the ground, the lead-covered cables are protected by an iron pipe.

The Newton station is also connected with the L Street station by means of a tie line which passes through Needham, Dedham and Roxbury; so in case both the boulevard circuits are killed or in serious trouble, an alternative route becomes available at once. This line is also a No. 0 double three-phase layout. It runs underground between the Newton station and Winchester Street, changing to overhead construction at the latter point. The town of Wellesley, 15 miles west of Boston and probably the rational suburban limit at the present time, is supplied with current from L street via Newton over a three-phase, four-wire line between the Newton station and the Wellesley boundary. The Edison circuits, however, are carried to South Framingham and beyond to a point

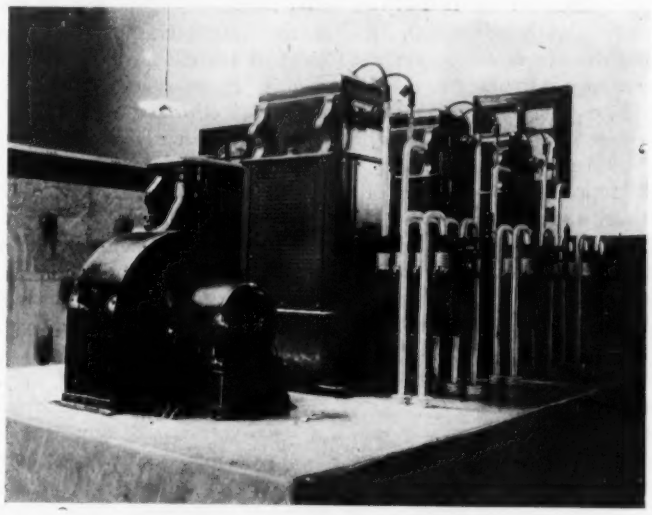


FIG. 3.—AIR-BLAST AND AIR-COOLED TRANSFORMERS.

nearly 25 miles west of the L Street station. At first blush there would seem to be cause for inquiry as to the comparatively low voltage used in these suburban transmissions, but the reason is clearly this: The circuits are laid out for a much greater volume of business than at present is handled by them, so that the drop with 6,900 volts is by no means excessive. All the sub-station and line construction is executed on a 15,000-volt basis, so that when the business increases sufficiently the potential can be raised and hence the line transmission capacity augmented, much as was the case at Niagara Falls several years ago. The Newton-Wellesley circuit has a No. 0 neutral wire and No. 00 copper phase wires.

The present equipment at Newton consists of three 200-kw, 6,900-volt to 2,300-volt, 60-cycle, General Electric air blast transformers; three 50-kw oil-cooled transformers of the same ratio, a 6,900-volt switchboard, 2,300-volt board, four 60-light tub transformers and corresponding panels. The transformer primaries are delta-connected and the secondaries star-connected, so that between the opposite legs of the star the potential is about 4,000 volts. No direct-current apparatus is in the station; not a single direct-current motor or lamp is in operation upon the company's circuits in the Newtons or Watertown. There are a number of single-phase motor installations, notably a factory plant in West Newton which also employs electric heating in some of its operations. All the arc lamps in Newton and Watertown are of the alternating enclosed type, and a considerable number of series incandescents are employed also for street service. The distribution from the Newton sub-station is all single-phase, with the exception of the Wellesley line. The air blast transformers are cooled by a 36-in. Buffalo Forge blower direct-driven by a 220-volt, three-phase induction motor at 1,800 r.p.m.

The oil transformers are set in galvanized-iron pans 1 in. deep. These transformers are ordinarily operated from 12.35 a.m.—the time the street incandescents are shut off—to the time the peak load begins to come on in the afternoon, which is generally from 3 to 5 o'clock. The air blast units are operated the balance of the time. This arrangement results in increased efficiency, on account of the difference in size of transformer units, and also reduces the losses incurred by running the air blast fan and motor long periods

of time. In this station watt-hour records are kept of the energy consumed by the fan motor, and every care is taken not to waste energy. Careful logs of the output and load are kept hourly, and a recent example of present load conditions is as follows, the date being Aug. 16, 1906:

TOTAL LOAD.

Aug. 16— Time.	K.W.	Time.	K.W.	Time.	K.W.
8 A.M.	60	4 P.M.	75	12 Mid.	362
9	90	5	70	1 A.M.	167
10	70	6	75	2	167
11	73	7	437	3	165
12	56	8	542	4	165
1 P.M.	57	9	512	5	50
2	65	10	462	6	47
3	65	11	397	7	50

—Aug. 17, 1906.

The bulk of the output is for lighting service, as one would naturally expect in a residential suburb. The tremendous multiplication of output as the hours of darkness set in and the precipitous falling off in the early morning hours are significant in the electric lighting business. Indicating wattmeters calibrated in kilowatts are in service on the 6,900-volt switchboard, as well as recording instruments. The air blast transformers, and also the blower, are set upon steel foundations with felt strips under the bases to make an air-tight joint. The fan motor is started by connecting it across the 220-volt bus-bars.

Practically all the wiring is carried through the station in ducts beneath the operating room floor. In general each switchboard is provided with two sets of bus-bars and oil switches with time limit relays to facilitate the transfer of load or supply current from one bus to the other. The 6,900-volt board carries two sets of three-phase bus-bars, and the Needham or Boston three-phase lines, either one of either pair, may be thrown upon either bus. The primaries of either set of transformers may be operated upon either set of buses, as may the bus-bars of the tub transformer supply circuit. Similarly, on the 2,300-volt board, any single-phase outgoing circuit or the Wellesley three-phase, four-wire line—which carries 2,300-volt power—may be thrown upon one set or the other of buses. The latter are encased in wood, which was boiled in paraffine before installation. The 6,900-volt board consists of seven panels, all of blue Vermont marble. Each panel is 3 ft. wide.

Each entering three-phase line is provided with a panel of its own, and each set of transformers has its special panel. The 2,300-volt board has eight marble panels 3 ft. wide each. Five of these panels are devoted to single-phase feeders; one takes care of the Wellesley circuit, one is an auxiliary panel for station lighting and the blower motor, and one is the main panel controlling the transformer secondaries. A special feature of the switchboards is the provision of testing clips on the front of the panels, so that the instruments may be calibrated without destroying the connections behind the panels. The arc lines are equipped with the Palmer open-circuiting device. The sub-station is in continuous 24-hour service and is operated by three men in eight-hour shifts. These shifts are: 7 a.m.—3 p.m.; 3 p.m.—11 p.m.; 11 p.m.—7 a.m. Mr. H. J. Fox is in operating charge of the sub-station.

Eddy Currents in Slot-Wound Conductors.

By A. B. Field.

Attention was drawn, in a paper* published about a year ago, to the rather surprising rapidity with which the eddy-current losses in alternating-current armature windings and the like increase with increasing depth of conductor. Dealing only with those eddy-currents which are directly due to the field produced by the current in the conductors themselves, various curves and formulæ were given for the speedy determination of these losses for most of the usual types of winding. By way of illustration it was pointed out that windings occurring frequently in practice involve losses in the active part of some of the conductors, many times the nominal loss there (for example, in a ¾-in. deep conductor, with two conductors deep in the slot, the loss at 60 cycles, in the *active part* of the outer conductor may be some 4½ to 7½ times that occurring with the same amperes, direct current). The results given were all deduced theoretically, as the only test results available, while satisfying the writer as to the general correctness of his conclusions, were too incomplete to put forward. A few months

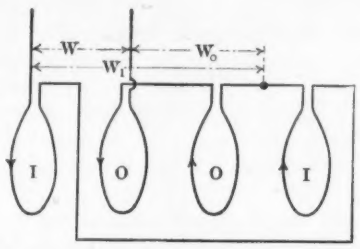


FIG. 1.—DIAGRAM OF TEST CONNECTIONS.

ago, however, some tests were made by the Bullock Electric Manufacturing Company to measure directly these losses under conditions allowing of a crucial check upon the calculations. It has been thought that these tests may be of some interest, taken in connection with the previous paper, and they are, therefore, summarized below.

An examination of the table will indicate that at 60 cycles, for instance, the losses in the coils *O O* by actual wattmeter measurements, amounted to 1.72 kw against .2 kw for the same amperes direct current. This corresponds to a loss in the embedded portion of nearly eleven times the nominal amount.

A small apparatus was built especially for the purpose of these tests, with a view to accentuating as much as possible the losses under investigation, minimizing all other losses, and operating at a high power factor, so that direct wattmeter determinations could be made with accuracy.

From the equations given in the paper referred to, it is a comparatively simple matter to obtain formulæ for the reactance of the windings, allowing for the disturbed state of the cross flux in the slot. Such considerations lead to exceedingly interesting results, but were omitted from the paper for want of space. Using such formulæ for reactance, it was estimated that by building a winding, as in Fig. 2, a power factor of about .55 would be obtained at a frequency of from 60 to 80 cycles (nearly constant power factor), and that the loss at 80 cycles and 2,000 amp. per sq. in. would be about 2.7 kw (average 70 watts per lb. of copper), thus allowing of direct measurement.

The apparatus consisted of two cores butting against one another; each core carried two coils connected in circuit to assist

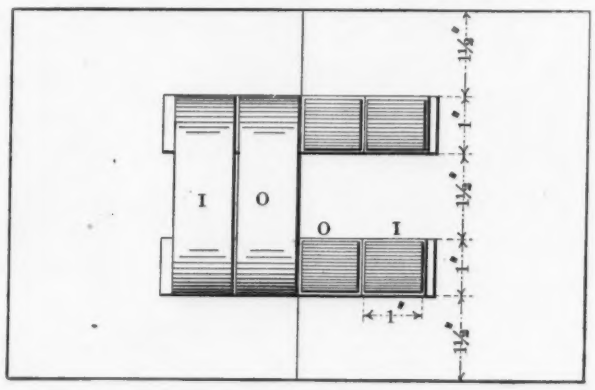


FIG. 2.—ARRANGEMENT OF TEST WINDINGS.

one another magnetically, but the coils of one core opposed those of the other. The apparatus, therefore, reproduced the conditions of a two-layer alternator winding, but with the external tooth-to-tooth leakage flux absent. The core was built up to a height of 15 in. with each .014-in. lamination sandwiched between two .01-in. paper sheets; the steel was carefully annealed. There were four coils, each wound with 15 turns of copper .05 in. by 1 in. The mean length of turn was 40 in.; ratio of active length to mean turn was .78. Resistance of each coil at 45° C. was .01 ohm. The coils were butted closely together, but the clearance representing insulation, etc., probably

*Transactions A. I. E. E., Vol. 24.

amounted to about .1 in. in each case, this figure was assumed in calculating the reactance. The predetermination of reactance, however, was only rough, on account of these uncertain clearances and the difficulty of estimating more than approximately the reactance of that part of the coil external to the core. Similarly the predetermined total loss was only intended to be within a few per cent; the coils necessarily heated very rapidly and very unevenly, while an average temperature of 45° C. was assumed in the calculation (except for 25 cycles). An allowance for the *O O* coils being hotter than the others would cause the test and calculated figures to come even closer together than recorded below.

In making the tests a number of readings were taken at each frequency with varying current; these were closely consistent, and, reduced to 100 amp., are equivalent to the averages below. The calculated figures are given in bold face type below the corresponding test figures, for the sake of comparison. Fig. 3 represents some of these results graphically.

It might perhaps be well to point out that the figure representing the watts loss in any coil is not necessarily equal to the watts input to that coil; that is, with current flowing in all four coils, the greater part of the power is *supplied* to the coils *I I*, but *appears* as heat in the coils *O O*. The reason for this is obvious and need not be outlined.

In the table, under the heading "kw loss," the figure for the *I I* coils is taken from the tested kilowatt input to the *O O* coils with no current flowing in *I I*. It is easy to see that this is correct, omitting the effect of difference of temperature. And for the loss in the *O O* coils, this figure is subtracted from the total loss, W, or W_1, as the case may be.

A portable wattmeter was used, with the non-inductive resistance of the shunt circuit replaced by some special ones; it appeared to give closely accurate results on the power factors occurring, as readings taken with widely different resistances in the shunt circuit checked fairly well. However, to determine with certainty whether the meter was reading appreciably high, and also to detect any possible core loss, four wire-wound coils were made with the conductor arranged so as to prevent cross

Tests were also made with the two cores separated by ½ in., thus allowing the trans-slot flux to bow out slightly at the mouth, as it would do under normal conditions. The loss was not measurably affected, though it probably would be, with a wider slot and more separation.

In conclusion it may be well to repeat the warning given in the original paper. The importance of these losses may be easily overestimated, and it is not intended, by drawing attention to them here, to condemn necessarily the use of solid conductors involving perhaps considerable losses in some parts of the windings. On the contrary, there is no doubt whatever that the use

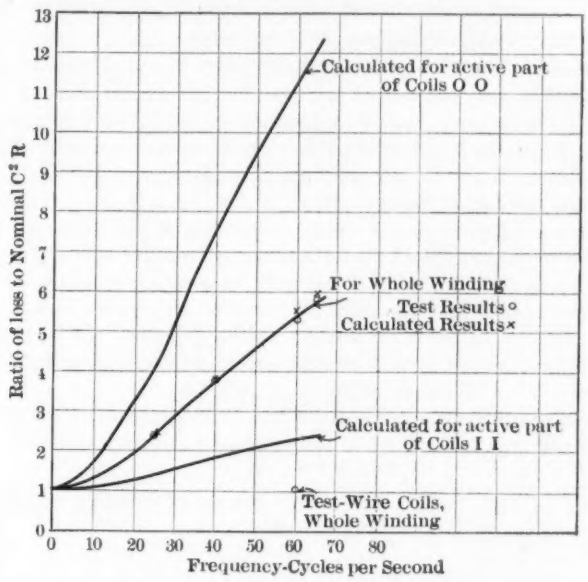


FIG. 3.—REPRESENTATION OF RESULTS OF TESTS.

of fairly deep conductors is, *in some cases*, entirely compatible with the best engineering design,† particularly for the conditions

Frequency.	Total—4 coils: K.W. (W.)	Volts.	P.F.	"K" Average.	Coils 11: K.W. Input (W_1).	K.W. Loss.	Volts.	P.F.	K. (active part).	Coils 00: K.W. Input (W_0).	K.W. Loss.	Volts.	P.F.	K (active part).
	2.33	44.5	.524	5.83	1.53	.428	29	.527		.81	1.9	15.2	.533	
	2.4	**43.7**	**.55**	**5.95**	**1.58**	**.42**	**29.3**	**.54**	**2.4**	**.81**	**1.98**	**14.2**	**.57**	**12.3**
		Current in coils 11 only.			1.16	.428	21.6	.536			.732			
65					**1.19**	**.42**	**22.1**	**.534**			**.76**			
		Current in coils 00 only.								.428	.428	7.16	.598	
										.42	**.42**	**6.86**	**.611**	**2.4**
	2.14	42	.51	5.34	1.425	.425	27.7	.514		.743	1.72	14.3	.52	
	2.22	**41.3**	**.54**	**5.55**	**1.463**	**.405**	**27.8**	**.527**	**2.3**	**.757**	**1.82**	**13.4**	**.563**	**11.4**
		Current in coils 11 only.			1.09	.425	21.3	.51			.665			
60					**1.11**	**.405**	**21.4**	**.52**			**.71**			
		Current in coils 00 only.								.425	.425	7	.608	
										.405	**.405**	**6.56**	**.618**	**2.3**
	1.53	33	.463	3.82	.965	.321	21.6	.446		.558	1.21	11.25	.496	
	1.55	**32.2**	**.48**	**3.88**	**1.002**	**.325**	**21.4**	**.468**	**1.8**	**.549**	**1.23**	**10.3**	**.531**	**7.6**
		Current in coils 11 only.			.77	.321	15.6	.495			.45			
40					**.775**	**.325**	**16.8**	**.461**			**.45**			
		Current in coils 00 only.								.321	.321	5.21	.616	
										.325	**.325**	**5.11**	**.635**	**1.8**
	.926	22.1	.419	2.4	.569	.26	14.8	.384		.37	.666	7.56	.49	
	.932	**21.5**	**.433**	**2.42**	**.572**	**.251**	**14.5**	**.395**	**1.39**	**.36**	**.681**	**7.15**	**.504**	**4.25**
		Current in coils 11 only.			.465	.26	10.88	.427			.205			
25					**.466**	**.251**	**11.35**	**.41**			**.215**			
		Current in coils 00 only.								.26	.26	3.96	.657	
										.251	**.251**	**3.66**	**.685**	**1.39**

Note.—The above figures correspond to 100 amperes. "K" is the ratio of actual C^2R loss in the part in question, to the loss that would occur with the same amperes direct current.

currents. Tests similar to the previous ones were made at 60 cycles with these wire coils; the results checked with the resistance measurements within from 30 to 40 watts. Hence, the effect of core loss and wattmeter discrepancy in the previous tests probably did not exceed 20 watts (at 100 amp., 60 cycles), and almost certainly did not exceed 50 watts. The conditions causing error (density in core and low power factor) were naturally much exaggerated in the wire-wound case.

obtaining in this country. The writer would, however, maintain that such losses should not be incurred without a full appreciation of their magnitude and effect.

† This opens up a large question which it is impossible to enter upon here, but any one will satsify himself on the point who will carefully analyze the location, and relative magnitude and importance, of the various losses occurring in, say, an alternator, considering also the means for dissipation of heat and facilities for conducting it to those parts where it can be dissipated, and the many other matters directly affecting the question.

Wind Pressure on Cylindrical Conductors.

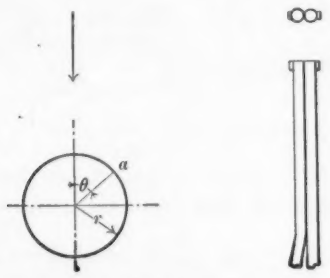
By A. J. Bowie, Jr.

In an article on "Long Span Pole Lines," which appeared in the issue of the Electrical World for August 25, mention was made of the fact that the wind pressure can be expressed by the formula $P = K V^2 \sin^2 \phi \times d$ per unit length, where d is the width of the surface, V is wind velocity and K is a constant, and that the value of K is a matter of some doubt. There is given below an outline of the theory connected with the determination of K and of the methods employed in experimentally verifying these determinations.

Under normal conditions at sea level when the density of the air is such that its weight is .0761 lbs. per cu. ft. corresponding to a temperature of 62° F. a barometric pressure of 29.92 and a humidity of 0, a pressure of 1 oz. per square inch will cause a velocity of 5,233 ft. per minute, or 59.4 miles per hour.

If an attempt is made to calculate the pressure on a cylindrical surface by regarding the normal pressure at any point as equal to the pressure caused by the component of the wind normal to the wire, then the normal pressure at any point in Fig. 1 will be $K V^2 \cos^2 \Theta$ and the intensity of pressure in the direction of the wind will be $K V^2 \cos^3 \Theta$. Multiplying by $r\, d\, \Theta$ and integrating between $\Theta = \pm 90°$ one obtains a total forward pressure on the front of the cylinder of $4/3\, r K V^2$.

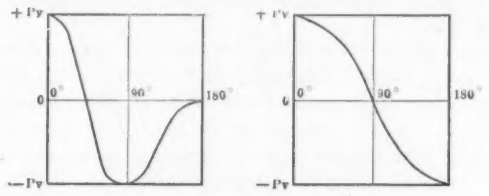
Disregarding the pressures on the back of the cylinder gives a total pressure of $\frac{2}{3} K d V^2$. According to a theory commonly accepted, the wind pressure on a flat normal surface of unit length and width d, which will be $K d V^2$, is that due to twice the velocity head of the air acting on the area. This is regarded as a positive pressure and no account is taken of negative pressures on the back. Hence the pressure on a cylinder should be $\frac{2}{3}$ the pressure on a flat plate of equal projected area. However, this theory of pressure distribution is entirely erroneous and the distribution of normal pressure is absolutely different from the results this would indicate.



FIGS. 1 AND 2.—DIAGRAM OF WIND FORCES AND SECTION OF DOUBLE PITOT TUBE.

Some years ago while experimenting on the flow of air, the writer devised a form of double Pitot tube for measuring direction and velocity of the air by means of a differential gauge. The double tube consisted of two small brass tubes soldered together with openings formed by small right-angle bends, 180° apart (see Fig. 2). As some of the results seemed unaccountable, an experiment was made by revolving the tubes in an air current and noting the pressures in only one side of the gauge. The results are shown in the curve of Fig. 3, which is quite different from the curve of Fig. 4, which is what one might expect according to the ordinary theory of the Pitot tube. These curves are plotted with pressures and angular positions of the gauge tube as co-ordinates. The pressure when facing the stream is that due to the sum of the pressure head Ph and the velocity head Pv. When 90° from this position, the pressure is roughly Ph-Pv, and when 180° from this position, and opposite to the air current it is Ph. The form of this curve would depend on the shape of the ends of the tubes. A consideration of these facts led to a way of determining the wind pressures on cylinders, which, however, was not undertaken at that time. If a closed tube of sufficient diameter with a small hole drilled in it, be placed in an air current, the pressure in the tube will be the normal component of the air pressure plus the existing static pressure. Ascertaining the static pressure and revolving the tube which is connected with a gauge, will enable the normal pressure distribution due to velocity to be plotted and hence the actual pressure in the direction of the air may be determined by multiplying the pressures at various points by the cosine of the angle between the normal and the direction of the air current.

In articles in London *Engineering*, March 17 and April 14, 1905, Dr. Geo. Finzi and Dr. Nicholas Soldati give an account of a most interesting series of experiments which they performed in determining the air pressures. The series of tests included the determination of the normal pressures on planes, cylinders,

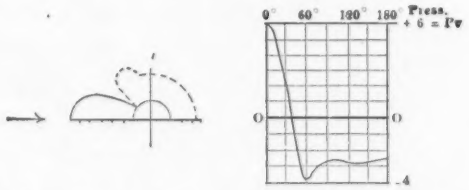


FIGS. 3 AND 4.—EXPERIMENTAL AND THEORETICAL CURVES OF WIND PRESSURE.

spheres and bodies of other shapes. The method of determination consisted in the use of a tube connected to small holes, normal to the surfaces, the other end of the tube being connected to a pressure gauge. Thus the pressure over the entire surface could be observed by point measurements, the pressure at any point being of course normal to the surface. It was definitely determined by the use of small porous plugs in the holes that the presence of the hole without the plug caused no perceptible effect on the actual pressure. Previous experiments on wind pressures had been made by measuring the pressure as a whole, and the wonderful array of formulae by eminent authorities who differed radically, showed in the light of these experiments that the cause of the difference lay in an erroneous theory, or rather on a theory based on either theoretical assumptions or on experimental data which were given too wide an interpretation.

While the above paper is perhaps not as complete as could be desired with regard to cylinders, yet it takes a most important step forward, and goes far toward fixing our ideas on proper formulae to use. In all cases the pressures vary directly with the first power of the velocity heads. This has been generally accepted. In the consideration of flat surfaces normal to the wind, the pressure may be regarded as composed of two parts: Front pressure and back pressure. The front pressure is greatest at the center of the figure, where its highest value is equal to that due to the velocity head. It falls off towards the edges. The gross front pressure for a circle is 75 per cent of that due to the velocity head; for a square it is 70 per cent, and for a rectangle, whose length is infinitely long compared with its width, it is 83.3 per cent.

Back pressures are nearly uniform over the whole area except at the edges. The striking fact is brought out that the back



FIGS. 5 AND 6.—OBSERVED WIND PRESSURES ON CYLINDRICAL SURFACE.

pressure is dependent on the perimeter of the plane and will vary between negative values of .4 and 1.00 of the positive velocity head, its value being expressed by the equation

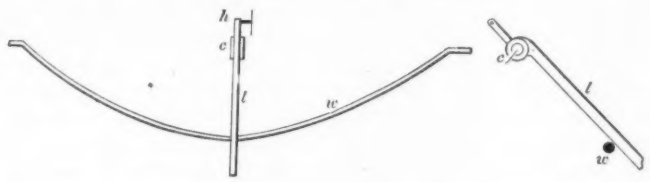
$$P = \frac{V^2 W}{2g} .4 + .15\, l - .0044\, l^2$$

where l is the perimeter in meters; the equation holds up to $l = 4$.

Thus the maximum total pressure on an indefinitely long rectangle of measurable width is 1.83 × velocity head pressure, and for a very small square the coefficient may be as small as 1.1. According to the theory usually accepted, this coefficient is taken as 2.

Pressures were observed around a cylinder 4.8 mm. diameter, and 25 cms. long, and the results are shown in Fig. 5, where the whole line shows the positive pressures on the semi-cylindrical surface, and the dotted line the negative pressures. Fig. 6 gives the corresponding results with the surface of the cylinder developed. These results integrated in the direction of wind velocity over the cylinder, give a coefficient of total pressure of .62 times the velocity head. The article does not state whether this is the pressure at the center of the cylinder or over the whole length. According to the general deductions if the pressure is for the center of the cylinder the same results would apply to cylinders indefinitely long, while if it is an average, it is probable that the figures would be increased for longer cylinders.

The statement is made that the pressure is such a value per inch of length, but presumably this is taken from the central section results. It is highly desirable that proper investigations should be conducted along the line of suitable coefficients for wind pressures, to see the effect, if any, which the wire diameter exerts on the wind pressure for a given projected area, and to determine whether the values should not be still greater for cable than for wire. This is particularly essential in long span work where the wind pressures for small wires will be liable to cause the greatest strains to which the wires will be subjected.



FIGS. 7 AND 8.—SKETCH OF APPARATUS FOR RECORDING THE WIND PRESSURE ON WIRES.

Until recently little reliable information on wind pressures was obtainable, and it was most unsatisfactory to rely on statements giving a coefficient of from .62 to 1.33. In view of the possible uncertainty of maximum wind velocities, great accuracy is quite unnecessary, but we should certainly be able to tell the correct coefficient within less than 100 per cent.

The following table taken from the article on air pressures, shows the coefficients for various surfaces.

Pressures per unit of area in terms of $\frac{V^2 W}{2g}$, where V = velocity per sec., W = weight of air per unit cube and g = acceleration of gravity per second in the same unit.

Description of surface.	Total.	Front.	Back.
10 cm. dia. disc	1.197	.750	.447
30 cm. dia. disc	1.292	.754	.538
100 cm. dia. disc	1.560	.747	.813
10x10 cm. square	1.150	.697	.453
30x30 cm. square	1.268	.696	.572
100x100 cm. square	1.590	.697	.893
10x30 rectangle	1.268	.752	.516
10x100 rectangle	1.484	.771	.713
30x100 rectangle	1.510	.753	.757
4.8 mm.D. x 25 cms. cylinder	.626	.222	.401
4.8x25 rectangle	1.244	.756	.488
Long rectangle	1.833	.833	1.00

The results are not given in this form, but have been calculated from the data in the article.

Some few attempts have been made to obtain data on wind pressures on wires. Among others may be mentioned the tests of Mr. H. W. Buck, reported in a paper read at the World's Fair in St. Louis in 1904. The tests were made at Niagara on a 950-ft. span, erected so as to be normal to the usual wind. The pressure was determined by assuming the force required to pull the center of the span back to a central position to be half the total pressure of the wind—on the cable—and the formula derived was $P = .0025\ V^2$ where P = pressure in pounds per sq. ft. of projected cable, and V = wind velocity in miles per hour. A formula derived by previous experimenters on solid wire is $P = .002\ V^2$, and Mr. Buck attributes the 25 per cent increase to the fact that in his work cable was used instead of wire, presenting thus increased surface for pressure for a given diameter.

Unfortunately in the published account of those experiments no account is given of the barometer or of the temperature of the air. The former, near sea level probably would make little variation, but the change due to the latter might be very great.

The pressure is dependent on the square of the velocity and on the density of the air. Assuming the barometer constant, at 29.92 inches 1 cubic foot of air with 80 per cent humidity weighs at 102° F. .0692 lbs., and at 0° F. .0864 lbs., an increase of 25 per cent. If we assume dry air at 62° F. at sea level to have to be used, then according to Mr. Buck the pressure is that due to 98 per cent of the velocity head of air on the projected surface, and by the other formula 79 per cent of the same.

By measuring the angle of deflection of the wire, it would be possible to tell very accurately the wind pressure normal to the line. The tangent of the angle the plane of the wire makes with the vertical shows the ratio of wind pressure to the weight of the wire. The following would be a simple and feasible method for keeping record of or measuring the wind pressures on wires.

In the center of the wire and center c of the span (Figs. 7 and 8), there should be pivoted a lever l, which has its side held constantly against the wire w. The pencil h, can be arranged to trace on a paper the angle through which the wire swings.

Factors Determining the Design of Needle Galvanometers.

BY L. A. FREUDENBERGER.

THE strength of field, f (in the direction OA, Fig. 1) at an axial distance x from the plane of a circular coil of wire is[1]

$$(1) \qquad f = 2\pi n i \frac{a^2}{r^3} = 2\pi n i \frac{\sin^2\theta}{r},$$

where i is the current and n the number of turns.

(2) Then $\frac{\sin^2\theta}{r}$ = a constant, or $r = p\ \sin^2\theta$ is the polar equation of the external boundary to which the galvanometer coils should be wound.[2]

In Fig. 2 is shown the proper shape of galvanometer coils,

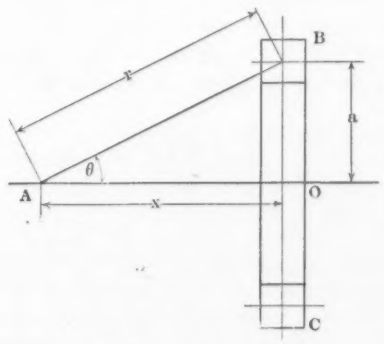


FIG. 1.—STRENGTH OF FIELD IN A NEEDLE GALVANOMETER.

after a chamber has been made for the needle.[3] The space taken by the needle chamber, the clearance between two halves of a coil, and the cylindrical channel running through the coil (the space occupied by the spindle of the winding form), unavoidably decrease the magnetizing action of the coil.

The method by which the following expressions are deduced can only be indicated, owing to lack of space.

Let the coil in Fig. 3 have the same magnetizing action on the suspended needle as the coil shown in Fig. 2. Also let $j = \frac{p}{q}$. The value of j will be represented quite closely by the

[1] J. J. Thomson's Elements of Electricity and Magnetism, p. 346.
[2] Gray's Absolute Measurements. pp. 371-372.
[3] Gray's Absolute Measurements, p. 376.

ratio of the external diameter of the coil to the diameter of the needle chamber.

The field, f, produced by the turns lying in a differential surface is first deduced from equation (1) and the total field obtained by integration. The wire being assumed to be wound in square order.

Thus

$$(3) \qquad f = \frac{3\pi^2 i p (1 - j)}{16 k^2 a^2},$$

where a is the radius of the bare wire and k is the ratio of diameters of covered and of bare wire.

The torque action on a suspended magnet, tending to bring it into the direction of the magnetic field is

(4) Torque $= M f \sin\phi$ where M is the magnetic moment of the magnet, f is the strength of the directing field and ϕ is the angle between the directing field and the axis of the magnet.

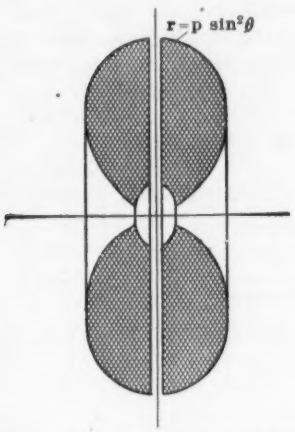


FIG. 2.—PROPER SHAPE FOR NEEDLE GALVANOMETER COILS.

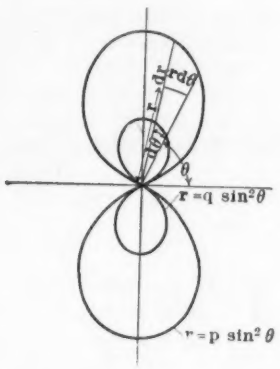


FIG. 3.—MAGNETIZING ACTION ON SUSPENDED NEEDLE.

In the Kelvin astatic galvanometer,

(5) $Mf \sin\phi - Mf' \sin\phi = M\Delta f \sin\phi$, is the directing torque (together with the torque, T, due to the suspension) on the suspended system, on account of the astatic arrangement of the magnets. ϕ is the angle of deflection (measured from the directing field), and f and f' are the strengths of the directing field at each magnet, Δf, representing the difference in the torque actions on the two magnets.

The expression for the deflecting torque (due to both coils) is then equated to the directing torque, giving

$$(6) \qquad i = \frac{8 k^3 a^3}{3\pi^2 p (1 - j)} \left[\Delta f \tan\phi + \frac{T}{M \cos\phi} \right]$$

for small deflections, $\cos\phi$ is nearly unity.

The above result shows that the deflections are independent of the magnetic moment of the magnets, provided that the torque due to the suspension is small enough. The needle chamber and magnets can thus be made as small as mechanical considerations will allow.

The resistance of the coils is next deduced, being

$$(7) \qquad R = \frac{32}{105} \frac{\rho p^3 (1 - j^3)}{k^2 a^4},$$

where R is the resistance of both coils, and ρ is the specific resistance of the wire.

Eliminating p in (6) by means of (7) gives

$$(8) \qquad i = \frac{16 \sqrt[8]{4}}{3\pi^2 \sqrt[8]{105}} \sqrt[8]{\frac{\rho (1 + j + j^2)}{R (1 - j)^2}} k^{4/3} a^{2/3} \left[\Delta f . \tan\phi + \frac{T}{M} \right].$$

In Fig. 4 are plotted the values of k for different sizes of single silk-covered wire: expressed with sufficient accuracy by the following:

$$(9) \qquad k = \frac{2.06}{a^{1.24}} + 1,$$

where a is the radius of the bare wire in mils.

In (8) eliminating a by means of (9) and equating to zero the first differential coefficient of i with respect to k (for minimum), gives $k = 1.56$ and $a = 2.75$ mils, corresponding to about a No. 36 B. & S. gauge wire ($a = 2.5$ mils.). No. 36 wire should thus be used in winding the coils of a Kelvin instrument, the size of coil being determined by the resistance desired.

By using graded sizes of wire (the grading being in proportion to the distance of a wire from the center of the coil) a slight increase in sensibility is obtained. The gain to be expected by using graded coils is as shown below:

$$\text{If } j = 0.25, \quad \frac{Graded}{Ungraded} = \frac{1.00}{2.86}.$$

$$\text{If } j = 0.50, \quad \frac{Graded}{Ungraded} = \frac{1.00}{2.34}.$$

The gain to be expected by using graded coils is thus comparatively small, and would be reduced still further in practice; since the above discussion assumes the wire to be graded uniformly in section from the inner to the outer layers. Not more than three or four different sizes of wire would be used, and also any departure from No. 36 wire would cause a loss.

The writer has built half a dozen Kelvin instruments and determined experimentally that the best size of wire lies in the vicinity of the size indicated. One of the best instruments constructed was wound with No. 36 wire to a resistance of 100 ohms. Coils 7/8 in. diameter, needle chamber 5/32 in. diameter, 1/8-in. magnets, 3/64-in. clearance between halves of a coil, wound

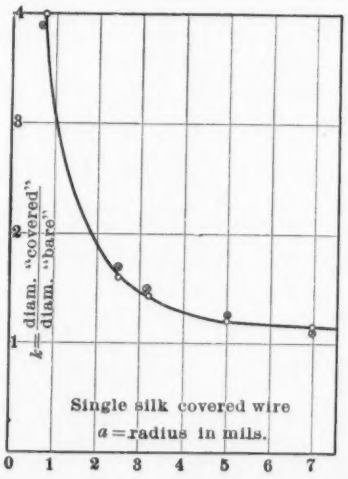


FIG. 4.—RELATION BETWEEN SIZE OF WIRE AND ITS COVERING.

on a 3/32 in. spindle. The sensibility obtained was 1.0×10^{-9} amperes per mm. per meter.

For high current sensibility a gain may be expected by the use of multiple astatic systems.

Let n be the number of coils (in the ordinary astatic galvanometer, $n = 2$) and let R_1 = resistance per coil.

Then (8) becomes

$$(9) \qquad \frac{32 \sqrt[8]{4}}{3\pi^2 \sqrt[8]{105}} \frac{k^{4/3} a^{2/3}}{n} \sqrt[8]{\frac{\rho (1 + j + j^2)}{n R_1 (1 - j)^2}} \left[\Delta f . \tan\phi + \frac{T}{M} \right].$$

Consider a double astatic instrument ($n = 4$) wound to the same total resistance as the single astatic instrument, using the same size of wire in the two cases (the same total resistance for the double system being obtained by making the coils slightly smaller). Then from (9), the deflection for a given current would be doubled.

The Hysteresis Exponent Experimentally Determined.

BY E. L. WEBER.

IN a stationary transformer with open-circuited secondary the magnetic flux in the core varies directly with the impressed e.m.f. and inversely with the frequency. Since the eddy-current loss varies directly with the square of the product of the flux density and the frequency, it follows that at constant impressed e.m.f. the eddy-current loss is unaltered by a change in the frequency. In consequence of this fact any change in the core loss with change in frequency, when the impressed e.m.f. is held constant in effective value and in wave form, may be attributed solely to a change in the hysteresis loss.

The hysteresis loss varies directly with the product of the first power of the frequency and a certain power of the flux density. Upon the value of this latter power, termed the hysteresis exponent, will depend the magnitude of the change in the core loss with change in the frequency, and the change in the core loss may be used as a means of determining the hysteresis exponent. The usual practice is to measure the core loss at three different frequencies. Let f_1, f_2 and f_3 be the three frequencies and W_1, W_2 and W_3 be the corresponding core losses. Then the following relations are found to be true:*

$$\frac{W_3 - W_1}{W_2 - W_1} = \frac{\left(\frac{f_1}{f_3}\right)^a - 1}{\left(\frac{f_1}{f_2}\right)^a - 1},$$

where $(1 + a)$ is equal to the hysteresis exponent.

For instance, for frequencies of 30, 45 and 60, there may be written:

$$\frac{W_{30} - W_{60}}{W_{45} - W_{60}} = \frac{2^a - 1}{1.33^a - 1}$$

or

$$\frac{W_{45} - W_{60}}{W_{30} - W_{60}} = \frac{1.33^a - 1}{2^a - 1}$$

The general equation thus obtained is of the form:

$$c = \frac{b^x - 1}{d^x - 1}.$$

In which c is a constant determined by the ratios of the differences of the core losses, b and d are the ratios of the frequencies and $x + 1$ is the hysteresis exponent.

In this equation x must be solved for by trial, and hence its solution is very tedious.

In order to assist in obtaining a rapid solution of this problem, the writer has constructed several curves with c as abscissæ and x as ordinates, for the following values: In curve c_1, $b = 1.33$, $d = 1.5$; in curve c_2, $b = 1.33$, $d = 2$; in curve c_3, $b = 1.33$, $d = 3$; in curve c_4, $b = 1.5$, $d = 2$; in curve c_5, $b = 1.5$, $d = 3$; in curve c_6, $b = 2$, $d = 3$; in curve c_7, $b = 2$, $d = 4$; in curve c_8, $b = 3$, $d = 6$.

It will be noted that values of x can be read most accurately when the slope of the curve, as plotted in the accompanying illustration, is greatest. From this fact it is evident that in order to obtain reliable results, frequencies of large ratios should be chosen, say, 1, 2 and 4, or 1, 3 and 6. The factor c being obtained from the differences of wattmeter readings, can also be determined more accurately by choosing frequencies of large ratios. If the frequencies used do not correspond to the ratios for which curves have been drawn, it is a simple matter to interpolate a curve for these frequencies by finding the value for c, where $x = 1$ and $x = .5$, and drawing a straight line through these two points, as the curves are practically straight lines within the narrow limits of their use in transformer testing.

As an illustration of the use of these curves, assume that with frequencies of 60, 90 and 120 the core losses at constant impressed e.m.f. are 18.71, 15.72 and 13.97 watts, respectively. Then the formula is:

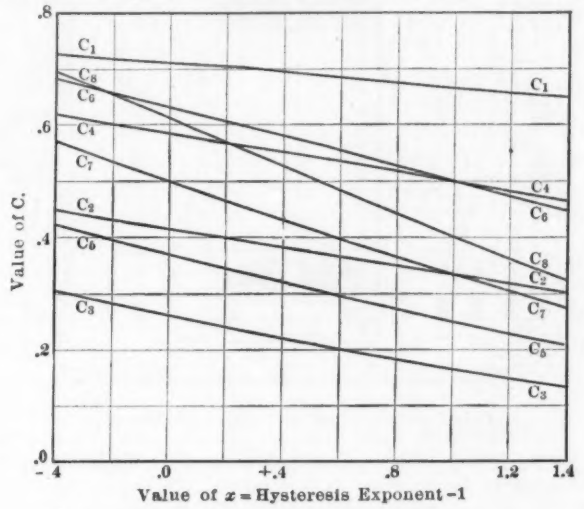
$$\frac{W_{90} - W_{120}}{W_{60} - W_{120}} = \frac{\left(\frac{120}{90}\right)^x - 1}{\left(\frac{120}{60}\right)^x - 1}$$

$$\frac{15.72 - 13.97}{18.71 - 13.97} = \frac{1.33^x - 1}{2^x - 1}$$

or

$$.369 = \frac{1.33^x - 1}{2^x - 1}$$

With these frequencies use is made of curve c_2. At the point



HYSTERESIS EXPONENT CURVES.

where c has the value .369, x equals .55, so that the hysteresis exponent is 1.55.

*See Baum's "Alternating Current Transformer," p. 95.

High-Speed, Low-Frequency Inductor Alternators.

In the ordinary type of inductor alternator it is necessary to

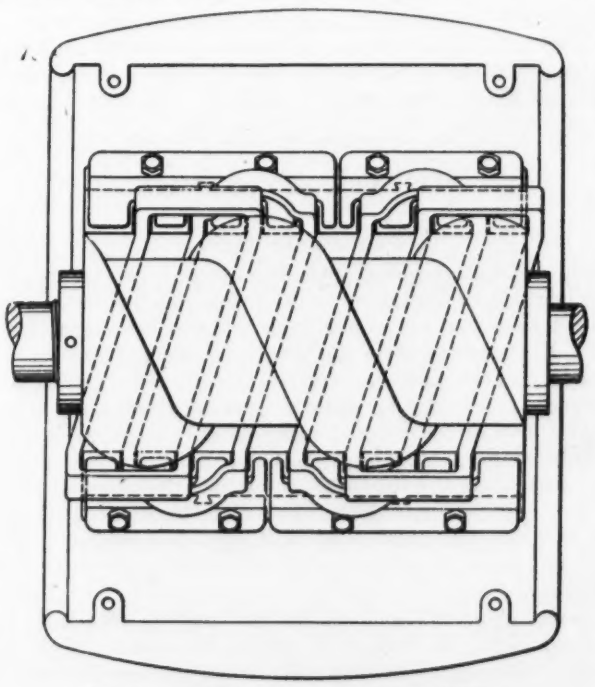


FIG. 1.—KELSEY INDUCTION ALTERNATOR.

employ at least two poles on each end of the inductor in order to secure proper mechanical balance. Thus such a machine possesses at least four poles, and if designed to deliver 25-cycle cur-

rent it must run at 750 r.p.m. Although inductor alternators are in many respects well adapted for use with steam turbines, the limiting speed for commercial frequencies is too low for most efficient operation. Two patents issued September 18 to Mr. C. A. Kelsey and Mr. D. B. Rushmore, respectively, relate to methods by which inductor alternators may be constructed with only two poles while yet retaining proper mechanical balance, so that they will give 25 cycles at 1,500 r.p.m.

The arrangement proposed by Mr. Kelsey, which is shown in Fig. 1, embodies the use of an inductor with a single helical projection. Since only one polar projection is employed, the machine

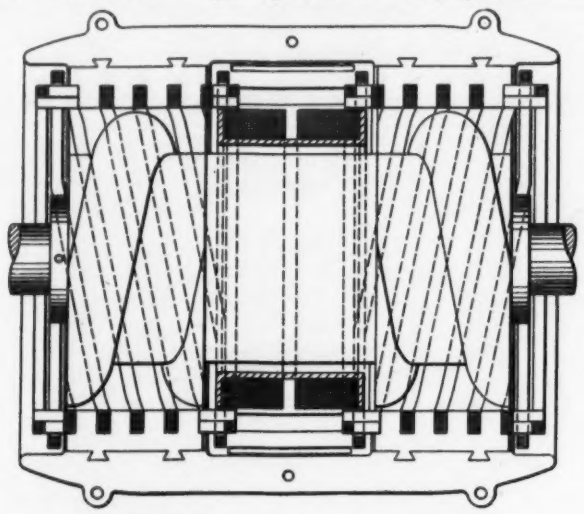


FIG. 2.—RUSHMORE INDUCTOR ALTERNATOR.

gives only one cycle for each revolution, while the helical arrangement permits the inductor to be mechanically balanced.

In the arrangement proposed by Mr. Rushmore, as indicated in Fig. 2, the inductor is provided with a helical projection at each end, these projections being oppositely arranged—that is, if one helix is considered as right-handed, the other one is left-handed. The armature coils are arranged in helical slots in the laminated rings of the stator body, while the field coils are supported by the stator beneath the magnetic bridge joining the two laminated rings. The field coils magnetize the inductor so that one helical projection will be of north polarity and the other of south polarity. The helical projections act as blowers to draw air in from both ends towards the center and to discharge it through holes in the central portion of the armature body. The inductor is balanced both as regards the axial wind pressure and the magnetic thrust, as well as mechanically with reference to the disposition of the revolving mass.

New Telephone Patents.

SWITCHBOARD CIRCUITS.

With multiple terminal switchboards it is, of course, a first principle that every line in use at any terminal must be guarded against attempted use at any other terminal by means of a busy test. Nevertheless, there are occasions where it becomes necessary to countermand the busy test or otherwise modify its significance. This may be done by superimposing upon the usual click, a hum or tone, and in many cases this special test may be introduced by a plug with no other function; however, there are cases where it is advisable to provide the plugs with circuits for full talking connection. Such a combination of special test and talking plug forms the basis of a patent issued to C. E. Wilson, of Chicago, which patent has been assigned to the Kellogg Company.

A second patent, assigned to the Kellogg Company, is one granted to W. W. Dean for a private line system of the central energy and central ringing type. The stations receive current through differentially wound relays. The windings balance under the influence of the transmitter current, which is fed metallic. When, however, one leg of the line is grounded by the ringing key at any station, the differential relay operates to clear the other limb of the battery and to connect it to the ringing source. All bells are, of course, legged off this side of the line and may be rung upon a code system.

Another patent of the same inventor, but in this case assigned to the Western Electric Company, provides a selective line signal. Each line has four line signals, each controlled by its own relay. The subscriber may select among his four signals at will by anyone of four keys. The circuit is shown in Fig. 1. It must first be noted that the battery supply for all lamps passes successively from one relay to the next. Thus, relay b^3 is the first of the series and controls not only its own lamp, b, but also prevents the other lamps from glowing irrespective of the condition of their corresponding relays. Relay b^3 responds only to current from battery h^2 because it is polarized so that no other possible current affects it. Relay c^3 is a consequent pole relay with closed magnetic circuit for any one of its windings,

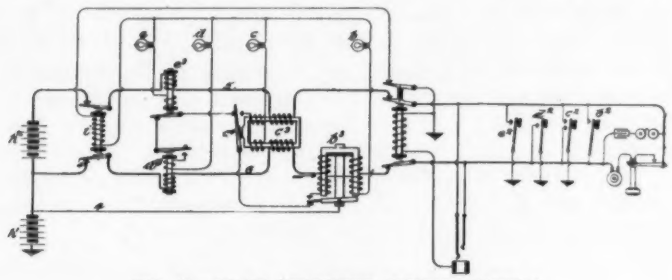


FIG. 1.—DEAN SELECTIVE SIGNAL SYSTEM.

but energized by "bucking" two windings to form a consequent pole near the armature. This responds to key c^2. Relays d^3 and e^3 are of the usual construction.

As soon as any relay is operated it locks and at the same time energizes the auxiliary cut-off relay, i, which cuts off all the signal relays to prevent this display of a second signal. The response of any operator restores the signal apparatus.

BRIDGING CONNECTOR.

A great deal of time and thought has been put upon the subject of bridging taps upon a line. Early methods involved calling and soldering and what not, but of recent years different forms of connectors have been tried one after the other. In Fig. 2 is shown a late design which bids fair to fill the bill. This is

FIG. 2.—BRIDGING CONNECTOR.

small and compact and can be protected against the weather. With the explanation that the line wire lies in a slot cut from the root to the head of the bolt, the illustration becomes self-explanatory. The patent, obtained by M. C. Turner, has been assigned to the New York Telephone Company.

PARTY LINES.

The number of patents for step-by-step and lock-out party lines shows no diminution, such devices being apparently endless in variety. R. C. Hastings and T. Matheny, of Athens, Ohio, have brought out a system requiring three wires between stations. O. H. Newman, of Pekin, Ill., has patented a system in which the actuating currents are all produced by the magneto hand generator of the calling station. The system is for private lines and depends upon each user restoring the apparatus to normal after using. C. R. and D. R. Green, of Rising Sun, Ind., have also invented a lock-out system. An escapement permits the controlled movement of a cam cylinder at each station, which effects the series of contact changes.

G. Babcock, of Chicago, has developed further improvements in his system, three comprising simultaneous selection of called and calling station by the operator, to save time. Formerly the operator had to select these at different times.

SECRECY KEY.

In order to prevent listening in on the part of operators,

W. M. Brown, of Johnstown, Pa., has developed a key to prevent the operator listening to the two stations at the same time if everything is normal. Unfortunately, any attempt of the operator to listen severs the connection, a most annoying feature from the subscribers' standpoint. Furthermore, there seems to be no reason why a connection cannot be established with two pairs of cords whereby the operator could listen throughout the connection.

AUXILIARY BELL RINGER.

A. G. Kountz, of Mount Oliver, Pa., has invented an auxiliary ringing device which is operated by the clapper of the magneto ringer. This consists of a switch which may be set to fall and close an auxiliary vibrating bell circuit, or to close the auxiliary circuit only during the vibration of the clapper.

TELEPHONE LINE.

C. V. Beaver, of Anita, Iowa, has patented a telephone line arrangement for cases where a large number of stations cuts down the transmission. His idea is to keep his main line clear of all branches, but to parallel it with an auxiliary line of sufficient length to pick up the talking and signaling currents by induction. The idea does not seem very practical.

COMBINED FIRE ALARM AND TELEPHONE SYSTEM.

We have mentioned before the low time efficiency of a telephone wire plant and the advantages of increasing its usefulness by arranging some service for the idle time. Of course, messengers, fire, burglar and watchman alarm systems suggest themselves as auxiliary service. Several patents have appeared in the past for such combinations and there have recently been issued to H. G. Webster five patents showing combined fire alarm and telephone systems. These depend upon differentiation between the fire alarm and telephone signal currents such that the alarm currents do not set the telephone signals nor vice versa. The alarm current is of insufficient power to affect the line relay and the telephone signal acts differentially on the alarm relay.

LETTER TO THE EDITORS.

Telephone Party Lines.

To the Editors of Electrical World:

SIRS:—In your editorial in the issue of the ELECTRICAL WORLD of the 8th inst. on "Novelties Wanted," you ask: "When shall there be a party telephone line on which long-eared busy-bodies shall not know who else is called . . . ?"

I am interested in a patent for a simple and effective lock-out attachment for telephones, but have been told by two of the largest telephone corporations and by a large manufacturing concern that a lock-out feature is not desired even if it could be applied at practically no expense to existing systems, and that this is particularly true as applied to farmers' lines where, one would think, with the large number of parties on one line, it would be most sought after. I am told that lock-out mechanisms on the lines would decrease, rather than increase rentals to subscribers! It would seem, then, that the public, or at least quite a majority of telephone users, would look with disfavor upon a system where they would be "estopped from butting in"; a sad commentary on human nature!

WATERVLIET, N. Y. J. B. MACNOUME.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Brushes.—ARNOLD.—An account of an experimental investigation of dynamo brushes. Brushes, free from vibration and operated with direct current, were tested, especially regarding the transition resistance as a function of the direction of the current, of the chemical condition of the contact surface, of the temperature, of the current density, and of the pressure with which the brush is pressed against the commutator. Some notes are also given on the behavior of vibrating brushes and on the behavior of brushes with quickly varying current densities.—*Elek. u. Masch.*, July 29. An English translation with illustrations in Lond. *Elec. Eng.*, September 7.

Mechanical Construction of Generators.—LIVINGSTONE.—The conclusion of his illustrated paper read before the Dick Kerr Engineering Society. The author deals with the design of the spider hub and with the stresses in the spider arms. He finally makes some remarks on the calculation of stresses in alternator frames, and points out that usually the stresses to which such frames are subjected are much greater while the machine is under course of construction than after it has been installed. A horizontally divided alternator frame is liable to be picked up, as shown in Fig. 1, and when the two halves are being fitted together it sometimes happens that the condition represented by Fig. 2 is realized. Such a condition ought never to exist; but it is a possibility which it is well to provide for. Frames which are designed to withstand such rough treatment can be relied on to withstand the comparatively mild stress to which they are subjected under working conditions. Another point which must be considered when "getting out" a new design for an alternator frame is that the same frame should be made suitable for being increased to the maximum width of machine of that particular diameter, and that it should also be made strong enough to take the maximum depth of punchings for that particular bore of frame. As the frames are seldom subjected to the severe stresses they receive while under process of erection, it is possible to run the stresses very high—even as high as 50 per cent of the elastic limit of the material. The curve shown in Fig. 3 gives the thickness of metal corresponding to different ratios of depth of section to bore of frame, necessary to withstand the treatment indicated.—Lond. *Elec.*, September 7.

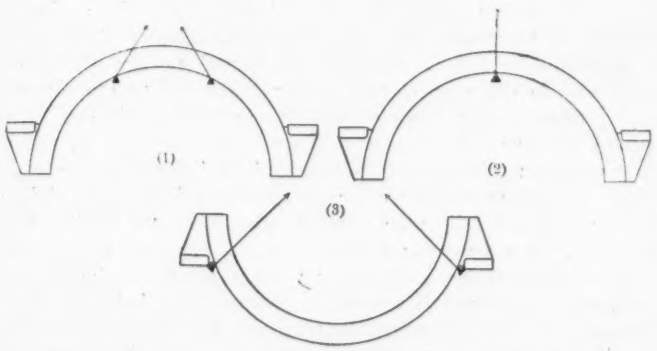


FIG. 1.—METHODS OF HANDLING ALTERNATOR FRAMES.

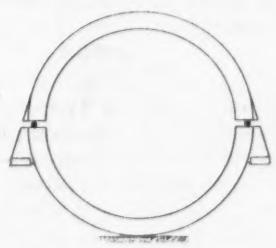


FIG. 2.—FITTING TOP TO BOTTOM OF FRAME.

Brush Holders.—SCHLEGEL.—An illustrated article pointing out the importance of an effective brush holder construction, especially in street railway service. The writer discusses various

motor troubles, which may be ascribed to faulty brush holders or poor inspection, and shows how they may be avoided by proper methods of brush holder construction.—*St. R'y Jour.*, September 8.

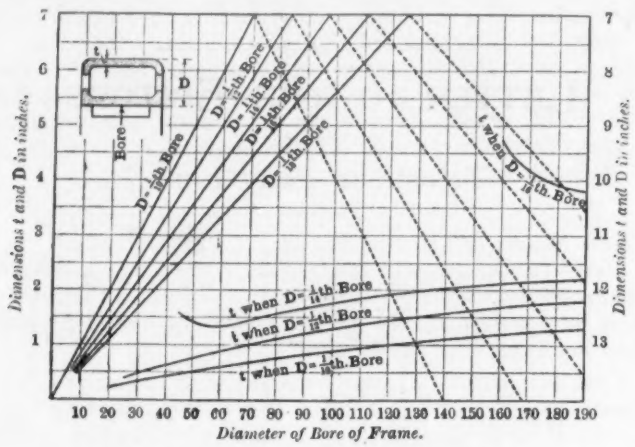

Dimensions t and D in inches.
Dimensions t and D in inches.
Bore
D
t
D = 1/8th Bore
D = 1/10th Bore
D = 1/11th Bore
D = 1/12th Bore
D = 1/13th Bore
t when D = 1/8th Bore
t when D = 1/10th Bore
t when D = 1/11th Bore
t when D = 1/12th Bore
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190
Diameter of Bore of Frame.

FIG. 3.—PROPORTIONS OF GENERATORS.

Influence Machines.—Woll.—The first part of an illustrated description of recent improvements in the construction of static influence machines, and a summary of recent investigations in this field.—*Elek. u. Masch.*, August 12.

Power.

Electric Power in Mines.—Allen.—A long illustrated article on electric machinery for the operation of Mexican mines. After an historical introduction, the author discusses especially the equipment at El Oro. Formerly the large amount of power used in that camp and vicinity was developed by steam, with wood costing from $3.50 to $4.50 per cord, and American coal at $11 per ton, U. S. currency. In view of this fact the Mexican Light & Power Company decided to extend its transmission (already operating from Necaxa to Mexico City) 90 miles further to El Oro, the circuit thus forming an obtuse angle, with Mexico City at the apex. It contracted with the three largest mines for approximately 10,000 hp. The source of electric power for the entire El Oro district is 71 miles distant, near Necaxa. The first plant now being installed utilizes two falls, giving about 40,000 hp. Six 5,000-kw alternators generate three-phase, 4,000-volt, 50-cycle currents. For transmission the voltage is raised to 60,000. The El Oro Mining & Railway Co. utilizes motors, etc., aggregating some 4,000 hp. "The only tool in use which seemed to defy motor application was the steam trip-hammer in the blacksmith shop. This finally succumbed, however, and is operated by compressed air supplied from an electrically-driven compressor." All the motors employed are three-phase, 50-cycle, and as a rule are 400-volt induction motors for 200 hp and less, and 3,000-volt synchronous motors above 200 hp. The equipment is described in detail.—*Eng'g Mag.*, September.

Gas Power.—Dalby.—A British Association paper on suction gas plants.—Lond. *Eng'ing*, August 10.

Bridge Construction.—A full description of the various applications of electric power in the erection of the King Edward bridge in Newcastle-on-Tyne.—Lond. *Elec. Rev.*, August 17.

Traction.

Tramway Brakes.—Scholtes and Bjorkegren.—Two reports to the International Association of Tramways and Light Railways, on the relative advantages and disadvantages of different systems of tramway brakes. Since the two reporters could not fully agree with each other, they submitted separate reports. The conclusions of Scholtes are as follows: "In the choice of a brake system all the particular circumstances of the service should be taken into account. The application of each of the three systems, hand brake, electric brake and air brake, should be carefully studied. Braking should take place without shocks. The equipment of the car should include two systems of brakes, completely independent of one another. The brake in general use should be such as not to cause fatigue to the driver. When, on account of the weight of the cars, on account of trailers, or on account of difficulties of the route, the hand brake cannot rationally be employed, a mechanical brake should be used, preferably an electric brake. When the use of an electric brake for general purposes necessitates certain inconveniences, such as, for example, the choice of too large a motor, or too much graduation for the starting resistances, it would be well to employ a compressed air brake. The use of the latter system would be a necessity in the case of the cars being heavy or running at a high speed, or in event of trains including more than two trailers." The conclusions of Bjorkegren are as follows: "In the choice of a system of brakes, all the particular circumstances of the case should be taken into consideration. The application of each of the three systems—hand brake, electric brake and air brake—should be carefully studied. The brake for general use should allow of braking without shock, and should not cause fatigue to the driver. It should at the same time, be suitable for use in case of emergency and as such should work sufficiently rapidly and certainly. In addition to this brake for general use, the equipment of the car should include a second brake (an auxiliary brake). When on account of the weight of the cars, the use of trailers, or on account of the route, the hand brake can no longer be rationally used as a service brake, a mechanical brake should be used, either an electric brake or an air brake."—Lond. *Elec.*, September 7.

Brakes.—Fox.—In an article on some European brakes and their value the author reviews some recent brake tests made in England during which a maximum retardation of nearly 7 miles per hour per second was secured with a magnetic track brake on a greasy rail without sand. He then discusses the conditions under which regenerative braking is advisable.—*St. Ry. Jour.*, September 15.

Interurban Train-Testing Apparatus.—Ashe.—A description of a recording instrument which the author has devised for interurban and elevated railway train testing. The instrument records line voltage, motor current, wheel revolutions, time in ½ seconds and instantaneous speed. The instrument is built upon lines somewhat similar to the Keiley recorder. The article also contains an illustrated record of a test made with the instrument on the elevated divisions of the Brooklyn Rapid Transit Company.—*St. R'y Jour.*, September 8.

Inspection Car.—An illustrated description of an inspection car used in the Simplon Tunnel. It is fitted with a complete electric light installation for the examination of the interior of the tunnel.—Lond. *Elec.*, August 24.

Sanding Devices.—Kosch.—An illustrated description of several simple sanding devices for tramways to increase the friction between wheels and rails.—Lond. *Elec. Eng.*, August 17.

Installations, Systems and Appliances.

Electric Speed Regulation with Diesel Engines on Board Ship.—Del Proposto.—It is claimed that Diesel engines are particularly suitable for marine use, provided that a satisfactory transmission gear can be devised for starting, reversing and running at reduced speed, since the Diesel engine has the objectionable features of irreversibility and limited speed regulation. Some form of electric regulation is recommended. The simplest method is to mount the dynamo on the engine shaft, which is governed to run at constant speed, and to use the current from this to drive an electric motor connected to the propeller shaft, some simple form of switch gear being all that is required to vary the speed and direction of motion. In the author's system the dynamo is mounted as before on the engine shaft, but the propeller shaft with its motor is brought right up to the engine and can be coupled directly to the engine, when required, by a magnetic clutch. Thus at start, and when running at reduced speed or in the reverse direction, the clutch is free, and the electrical transmission is used as indicated above. When, however, the vessel is traveling forward at its normal speed, the clutch is put into engagement, and the motor and dynamo simply run around unexcited and with their brushes raised. A separate exciter is used for supplying current for the magnetic clutch. Some applications of this system are described.—Lond. *Elec.*, September 7.

Wires, Wiring and Conduits.

Break in Overhead Wires.—Hawthorne and Morton.—The authors have formerly given a theory of the deflections caused

by a break in an overhead wire carried on poles, under the supposition that the wires are inextensible. In the present supplementary note they take into account the elastic stretch that accompanies an increase of tension.—*Phil. Mag.*, September.

Inductive Capacity of Paper.—CAMPBELL.—An account of an investigation carried out in the British National Physical Laboratory on the specific inductive capacities of dry paper and of solid cellulose. One of the main difficulties in the testing of paper lies in the fact that it absorbs moisture so readily, and the presence of moisture has a large effect on the specific inductive capacity, and an enormous effect on the insulation resistance. The nature of these effects is well illustrated by the curve in Fig. 4, which shows how the capacity increases and the resist-

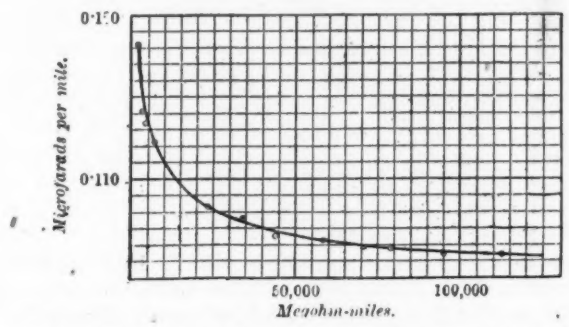


FIG. 4.—VARIATION OF CAPACITY WITH INSULATION RESISTANCE.

sistance decreases as a well-dried cable is allowed to absorb moisture from the atmosphere. After describing the methods of testing, he gives in a table the measurements of the inductive capacity of paper varying in thickness from 0.08 to 0.15 mm. The specific inductive capacity varies between 1.7 and 2.6, while that of solid cellulose is 6.8. The effect of temperature on the electric properties of the combination of air and dry paper as found in telephone cables is also shown by a diagram. The megohms per mile decrease from 20,000 at 15° to 2,500 at 44°, while the microfarads per mile increase from 0.122 at 15° to 0.131 at 44°.—Lond. *Elec.*, August 31.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—MAX WIEN.—A mathematical paper in which the author (who has formerly made valuable contributions to the theory of coupled transmitters) criticises sarcastically the series of articles of Slaby, which have appeared during the last two years on this subject. Slaby had claimed that his experiments showed the necessity of changing our views on the action of coupled transmitters and has also developed new equations. The present author endeavors to show that the experimental results of Slaby (as far as they are correct) agree with the former theories and that on the other hand Slaby's calculations are based on a wrong foundation and are not valid except perhaps in special cases, leading even then to inexact approximate formulas only. The author also calls attention to several discrepancies in Slaby's papers.—*Elek. Zeit.*, September 6.

Capacity and Inductance of Telegraph Lines.—DEVAUZ-CHARBONNEL.—An account of measurements of the capacity and inductance of telegraph lines. The capacity of aerial lines is greater than the theoretical value on account of the fact that the theory does not take into account the presence of neighboring conductors other than the soil. It varies with the moisture of the air. The author gives the following figures, which are in microfarads:

Per kilometer:	4-mm. wire.	5-mm. wire.
Theoretical capacity	0.0058	0.0060
Actual capacity, wet	0.0105	0.0120
Actual capacity, dry	0.0087	0.0090

For the inductance of copper lines, which are non-magnetic, the author found the following values in henrys per kilometer:

Aerial lines	0.00205
Underground lines insulated with gutta percha	0.00243
Underground lines insulated with paper	0.00198

For iron lines the figures are higher on account of the permeability of the metal, and as an average an inductance of 0.0060 henrys per kilometer may be taken.—Lond. *Elec.*, Aug. 31, from *Comptes Rendus*, July 9.

Electrophysics and Magnetism.

Ultra-Violet Light.—RAMSAY AND SPENCER.—A paper read before the British Association on "chemical and electrical changes induced by ultra-violet light." In their experiments the authors placed an electroscope of aluminum foil within an aluminum box, and held the plate of the metal or metalloid to be tested at an angle of 45 deg. near the condenser cap of the electroscope, which projected from the top of the box, so that the ultra-violet rays reflected from the plate fell on the cap of the electroscope. Thirty-five metals and several compounds had been examined. When the source of light was an arc between iron electrodes, the electroscope was discharged; but only when charged positively, not when charged negatively, to about 800 volts. The discharge was observed even when the electroscope was surrounded with leaf of gold or silver; aluminum leaf almost stopped the discharge, however. The iron arc proving unsteady, a Cooper-Hewitt mercury lamp, made of uviol glass was substituted for it. This illumination was insufficient to penetrate through any metallic leaf interposed, but falling directly on the electroscope plate, discharged the electroscope, again only when charged positively. It was ascertained that the more positive the metal illuminated in the voltaic series, the quicker the discharge; but the metals of the iron group, Fe, Co, Ni, Mn, W, which easily assume a passive state, would not fit into their positions at all. Palladium metal, charged with oxygen or hydrogen, which it absorbs, behaved like those gases; zinc amalgam produced a very rapid discharge. When the metal illuminated itself formed part of the electroscope, the discharge was much more rapid, again in the order of the voltaic series; but now the electroscope had to be charged negatively to 800 volts (not positively). Plates of sulphide, obtained by dipping the metal in ammonium sulphide, were then tried; also iodides; they produced slow discharges, and their order was certainly not that of the voltaic series. In all cases fresh metallic surfaces, several times cleaned with emery paper and polished, gave the best effects, and very peculiar fatigue effects were observed.—Lond. *Eng'g*, August 31.

Radioactivity.—LEVIN, EVE, HAHN.—Three papers on different subjects of radioactivity. The paper of Levin deals with the origin of the beta rays emitted by thorium and actinium, the paper by Eve with the radioactive matter in the earth and the atmosphere, the paper by Hahn with the ionization ranges of the alpha rays of actinium.—*Phil. Mag.*, September.

Current Between Parallel Plates.—BROWN.—An investigation of the potential required to maintain a current between parallel plates in a gas at low pressure in a spark-discharge. The author describes various peculiarities in the behavior of a spark-discharge, which tend to complicate an apparently simple investigation. However, the following results are established by his research: The potential required to maintain a current in general varies as the current is increased. At pressures above the "critical pressure" this value is lower than the sparking potential, tending toward a limiting value. At pressures below the critical pressure it at first rises very rapidly, as the current is increased, the smaller the pressure the more rapid being the rise.—*Phil. Mag.*, September.

Molecular Structure of Metals.—EWING.—His complete paper, an abstract of which was recently noticed in the Digest.—*Phil. Mag.*, September.

Color Phenomena in Photometry.—DOW.—A paper read before the British Phys. Society. The author discusses in detail the following four facts which may introduce uncertainties: First, the difficulty in forming a judgment in the case of different colored lights and the possibility that the judgment of different people may not be the same; second, the Purkinje phenomena; third, the possibility when mirrors are made use of, that the coefficient of deflection may not be the same for different colored lights; fourth, the fact that the apparent relative brightness of two surfaces, illuminated by light of different colors, depends on the part of the retina on which the image of them is received. The author concludes that the only really important effect, under ordinary working conditions, is the last-mentioned. He then discusses the question whether photometers of the flicker type are also influenced by these color phenomena. His con-

clusion from his experiments is that flicker photometers are effected by the same color phenomena as ordinary photometers.—Lond. *Elec.*, August 24.

Electrolytic Detectors.—Armagnat.—An article, illustrated by diagrams, on electrolytic detectors and their use in electrical measurements. The electrolytic detector furnishes a very easy means for detecting very small differences of alternating potentials, and Ferrie and Carpentier have proposed to apply it in all methods of reduction to zero, using alternating or pulsating currents. An application to the measurement of resistance of electrolytes is also described.—*La Rev. Elec.*, May 15 (published July 15).

Time Meter.—Wagmueller.—An illustrated paper read before the Berlin Electrical Society. He describes a new type of time meter in which no watch spring whatever is used. The spring is replaced by an electric motor, which is stated to result in a much simplified construction of the whole instrument. An application of this instrument for making periodical contacts is described.—*Elek. Zeit.*, August 30.

Cadmium Standard Cell.—Hulett.—A full account of his investigations of the cadmium cell, showing that the cathode system of the cadmium cell, as at present constructed, is not a system in equilibrium and that the e.m.f. of the cell decreases with time. For all ordinary purposes this cell is entirely satisfactory, but if there are no serious errors in the experiments recorded in this article the cadmium cell as at present constructed can hardly supplant the Clark cell as a primary standard of e.m.f.—*Phys. Rev.*, August.

Hardening Steel.—Taylor.—An abstract from a British Association paper on a magnetic indicator of temperature for use in hardening steel. It depends essentially on the fact that for hardening, the steel must be raised to a temperature at which it loses most of its permeability.—Lond. *Elec.*, August 10.

Measuring Phase Difference.—Drysdale.—A description of different methods for measuring phase differences. The author first describes a wattmeter deflectional method, then potential-difference or voltmeter methods, and finally wattmeter zero methods.—Lond. *Elec.*, August 24 and 31.

Magnetic Tests.—Taylor.—An article pointing out the limitations in the ballistic method for magnetic induction.—*Phys. Rev.*, August.

Electrochemistry and Batteries.

Induction Furnace.—Ibbotson.—An illustrated paper read before the Iron and Steel Institute, giving data on one year's operation at Gysinge in Sweden, of an induction furnace giving one ton (2,400 lbs.) of steel per tap. There were produced during the year 950 tons of tool steel and special castings. The average time taken per charge, for the year, when adding briquettes. was 7⅛ hrs., and the electrical energy consumed was 1,128 kw-hours per ton. The average time per charge for white iron and scrap charges was 5½ hours, and the electrical energy consumed was 886 kw-hours per ton. These consumptions include all time and energy lost from various causes, such as bad water supply, etc. Details are given of several runs with an analysis of steels produced, together with a diagram of the furnace.—*Electrochem. and Met. Ind.*, September.

Organic Chemistry.—Marie.—A concise review of the applications of electrochemical methods to research work in organic chemistry.—*Rev. Gel. des Sc.*, August 30.

Fused Electrolyte.—Ashcroft.—The concluding installment of his illustrated series on factory-scale experiments with fused electrolytes. The author suggests several new applications of his double electrolytic apparatus with magnetic stirring and circulation of the intermediate fused electrode.—*Electrochem. and Met. Ind.*, September.

Units, Measurements and Instruments.

Ballistic Galvanometers.—Wilson.—The author first gives the usual formulas for ballistic galvanometers, which are applicable only in special cases, and then develops more accurate formulas for ballistic galvanometers of several types. The following table sums up the results derived by the author:

Type of Galvanometer.	*Formulas.*
Tangent galvanometer with small needle at center of coil.	$Q=\frac{HT}{G\pi}\sin\frac{\Theta}{2}=\frac{T i \sin\Theta/2}{\pi \tan\phi}$
Astatic galvanometer of needles with purely torsional control.	$Q=\frac{T a \Theta}{2\pi M (G_1+G_2)}=\frac{T i \Theta \cos\phi}{2\pi\phi}$
Astatic galvanometer with purely magnetic control.	$Q=\frac{T (M_1H_1\cos a_1+M_2H_2\cos a_2)}{\pi (M_1G_1+M_2G_2)}\sin\frac{\Theta}{2}=\frac{T i \sin\Theta/2}{\pi\tan\phi}$
Moving-coil galvanometer with iron core and radial magnetic field.	$Q=\frac{T a \Theta}{2\pi C}=\frac{T i \Theta}{2\pi\phi}$
Moving-coil galvanometer with narrow coil and no iron core.	$Q=\frac{T a \Theta}{2\pi C}=\frac{T i \Theta\cos\phi}{2\pi\phi}$

In these formulas Q is the quantity of electricity passed through the galvanometer; H the magnetic field controlling the galvanometer needle; G the magnetic field at needle, supposed perpendicular to H, due to unit current in the coil; T the time of a complete oscillation of the needle; Θ the angle of swing of the needle from rest correction for damping; ϕ the steady angular deflection due to the current i; a is the couple exerted by the wire by which the coil is suspended when the coil is turned through the unit angle. In the formulas for the second type of galvanometer mentioned above, M is the moment of each needle, and G_1 and G_2 the fields due to unit current at the two needles respectively. In the formulas for the third type—astatic galvanometer controlled by magnetic fields at each needle—the controlling field at one needle is H_1, making an angle a_1 with the plane of this needle, and M_1 is the moment of this needle, while M_2 H_2 a_2 are the corresponding quantities for the other needle. The fourth type is superior to all others as regards the simplicity of the exact formula to be used with it. It is also superior in most other respects.—*Phil. Mag.*, September.

Electrometers.—Some notes on improvements in the construction of electrometers are mentioned in last year's report of the Reichsanstalt. In experimenting on electrometers, it has been found preferable to suspend movable parts by thin platinum strips rather than by fine wires. Very fine platinum wires are prepared by the Wollaston method, by drawing out silvered platinum wire and afterwards dissolving the external silver coating. Diesselhorst has rolled such wires, and although it was foreseen that the platinum core would not yield so much as the softer silver coating, the results are encouraging. Strips rolled from wires about 0.01 millimeter in diameter prove to be quite homogeneous; they can support as much weight as the wires, and are only inclined to twist about a third as much as these. Heating to high temperatures weakens the strips. Rolled copper-coated platinum wires were found not to answer. The electrometer formula of Maxwell is being supplemented. This necessitates elaborate research. Higher sensitiveness can be better secured, it would seem, by reducing the vertical distance between the needle, a change which does not affect the period of oscillations, rather than by making the needles longer. The new quadrant electrometer of H. Schultze consists of two separate parts; each part comprises a plane round disc of ebonite set with four sectors of brass of 90 deg.; the brasses of the two discs are above one another, and their distance is measured by means of four micrometer screws. The needle is made of magnalium, and air-damping is employed. When the discs are close to one another, no damping is needed to secure a periodic working.—Lond. *Eng'g*, August 31.

Miscellaneous.

Second Law of Thermodynamics.—W. S. Franklin.—A discussion of the second law of thermodynamics, its basis in intuition and common sense. The author points to the general

feeling which every one has of the irretrievable effects of disaster, and explains that degeneration in a thermodynamic sense means that the results of some processes are essentially irreparable, or can be repaired only at a certain cost. The most general statement of the second law of thermodynamics is to the effect that the thermodynamic degeneration which accompanies a turbulent process cannot be directly repaired, nor can it be repaired by any means without compensation. Some special statements of this general law are also given.—*Elec. Rev.*, September 8.

British Central Station.—An abstract of last year's final account of the West Ham municipal station which is now emerging from a period of high costs and deficits. There were sold last year 6,000,616 kw-hours, of which about 2,500,000 were sold to private consumers, 750,000 for public lighting, and about 2,800,000 for traction. The total cost per kw-hour sold including capital charges, was 3.910 cts.—Lond. *Elec.*, September 7.

Regulator.—BIRKL.—An illustrated description of a regulator for water wheels, etc., based upon a combination of the "principles of inertia and interference." "The variable speed of the main engine is brought into relation to the approximately constant speed of an auxiliary engine with the aid of a gearing method by which any difference between both speeds produces a corresponding motion of the regulating device of the main engine." The construction is described and the mathematical theory is given in detail.—*Elek. u. Masch.*, August 5.

BOOK REVIEW.

STRAY CURRENTS FROM ELECTRIC RAILWAYS. By Dr. Carl Michalke. Translated and Edited by Otis Allen Kenyon: McGraw Publishing Company. 101 pages, 34 illustrations. Price $1.50.

There are few subjects which have had more attention or which have been written more about than "Stray Currents and Electrolysis." The literature on this subject, however, is scattered through the principal technical papers of the world, and the present book performs a very valuable service in collecting and arranging the more important contributions to the subject.

The author has confined himself to a statement of facts, or to opinions advanced by the best known authorities. To the original German text, the translator has added a number of foot notes from American practice and a bibliography covering the American, British, French and German literature.

The book takes up in turn the nature of stray currents, giving mathematical expressions for their value; properties of the path through which the currents flow; the nature of corrosion; methods of making tests for stray currents and electrolysis, and methods of preventing electrolysis.

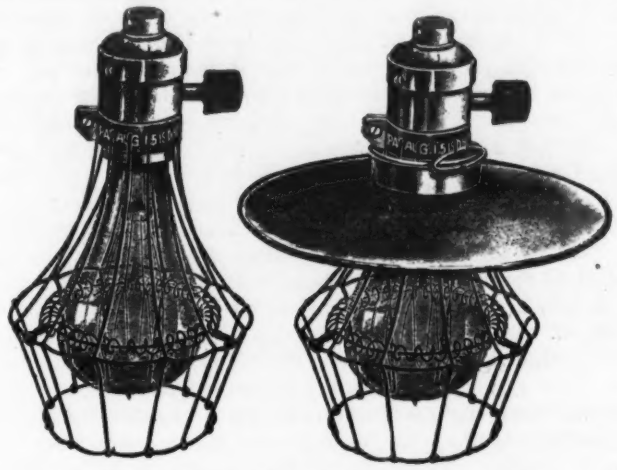
The mathematical treatment is divided into two parts, namely: Simple formulas, which are given in the text, and rigorous proofs of the formulas, which are given in the foot notes. The book contains a list of symbols and abbreviations and a comprehensive index. The press work is good and but one criticism can be made with reference to the binding, that is, there is no designation of the title on the back. The American editor has added largely to the value of this much-needed contribution to a subject concerning which in the past there has been much misunderstanding.

Guards for Incandescent Lamps.

The illustrations herewith, Figs. 1 and 2, show a new lamp guard. Fig. 1 shows the guard on a socket with the lamp inside, exemplifying the large air space. For bench work in factories it has two advantages. It will stand on end like an oil lamp and the downward rays of light are not obstructed. Another advantage is that it acts as a shade holder (Fig. 2). Any standard size shade will fit over it. The opening at the bottom permits the removal or replacing of lamps with ease.

The center spreading ring meets with all the impact upon the guard. Its rigid construction and outward extension forms a positive point for impact that prevents distortion or dislocation of any part of the guard when subject to severe usage. The spiral cushion also counteracts the effect of any jar or vibration.

A test for trying its efficiency consists in rigging up a drop cord, six to ten feet long and about two or three feet from a solid wall (brick or stone preferred). Attaching the guard to



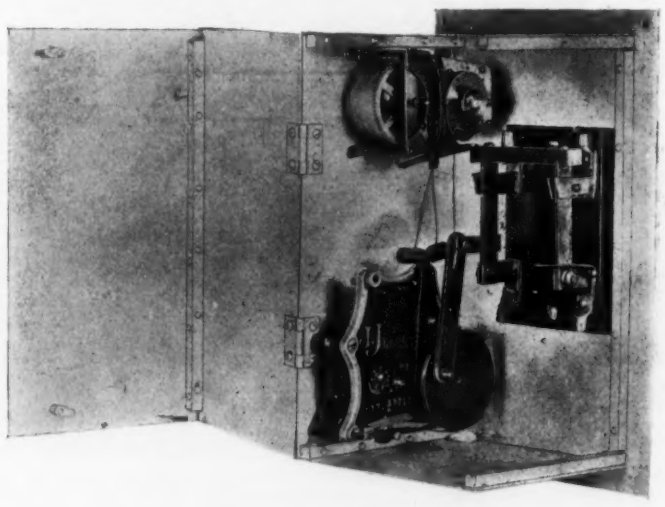
FIGS. 1 AND 2.—INCANDESCENT LAMP GUARDS.

the socket, the lamp is put in and the guard and lamp are dashed against the wall with force, but without damage. The Hold Fast Lamp Guard Company, of 227 North Second Street, St. Louis, are the manufacturers.

Automatic Time Switch.

The time switch illustrated herewith is of the quick-opening and quick-closing knife switch type. The opening and closing device consists of a powerful spring-driven mechanism which tends at all times to revolve a disc carrying a crank which operates a loosely-joined connecting rod. This rod serves to open or close the switch with a snap-break movement. The motion of the driving disc is arrested by means of a spring-controlled lever which is removed from contact with a lug on the disc through the agency of a hammer blow imparted by spring mechanisms.

The device is provided with two hammers, one for opening



AUTOMATIC TIME SWITCH.

and one for closing the switch. The movement of each of these hammers is governed by discs driven at the rate of one revolution during each 24 hours. Each disc carries a pin which raises a steel pin on the corresponding hammer, and allows the hammer to strike with a snap at the hour for which the disc is adjusted. The two discs are independently adjustable so that the switch may be set to open and close at any time desired.

This device, which is complete in an iron case ready to install, is built for 2, 3 or 4 poles and for any capacity from 35 to 200 amp. It is being placed on the market by the Jones Electrical Company, 62 Vesey Street, New York.

Oil Engine Generator Sets.

Owing to the cheapness and abundance of crude and fuel oils now on the market, the various types of internal combustion engines designed to use these oils have recently attracted considerable notice. A feature of these engines in their great economy compared with gasoline or steam engines, the amount of fuel required per hp-hour being less than a pound of oil, while the cost of the attendance is very low. Several types of crude and fuel oil electric generator sets have recently been brought out by the De La Vergne Machine Co., New York City. These engines are built in various sizes from 5 to 250 hp, the larger engines being of the twin-cylinder type. Some idea of their economy may be formed when it is known that with the average price of oil the fuel expense is stated to be from ¼ to ½ per cent per hp-hour or from ⅜ to ¾ cent per kw-hour when using crude or fuel oil.

The engine shown in Fig. 1 is the "Hornsby-Akroyd" oil engine. This type operates on the four-stroke cycle, and is distinguished from engines operating on gas or volatile fluids, such as gasoline, naphtha, etc., by the entire absence of electric batteries and other igniting mechanism, the charge being ignited by the heat of compression combined with that of the vaporizer, which is kept at a dull red heat by the successive explosions of the combustible mixture. The oil is stored in the base of the engine, and is supplied to the vaporizer by a small plunger pump. This pump is protected from the force of the explosions by a check valve at the end of the oil pipe just outside of the vaporizer. When too much oil is pumped for the load on the engine the governor opens a by-pass valve, Fig. 2, and the excess of oil is returned to the storage tank.

Every part of the engine that is liable to overheating is water jacketed, including the cylinder part of the vaporizer and the exhaust valve. In the larger sizes, from 100 hp up, the piston is also water cooled. The fact that the exhaust gases are expelled and the air is taken in through the same port tends to reduce the temperature to a value below that found when the exhaust port of an internal combustion engine is exposed.

When the oil enters the vaporizer it is gasified by the heat of the chamber. At the same time air is being drawn into the cylinder through the port, shown in Fig. 3. As the piston starts on its return stroke it begins to compress the air, forcing it through the narrow neck into the vaporizer where it mixes with the oil. The heat of compression combined with that from the vaporizer walls ignites the combustible mixture. With the exception of that of the heating lamp used under the vaporizer at starting only, there is no flame outside of the engines.

Internal combustion engines of all types have been rapidly coming into favor of late and the manufacturers of these engines have developed new types and larger sizes as they were demanded. To-day the installation of internal combustion engines

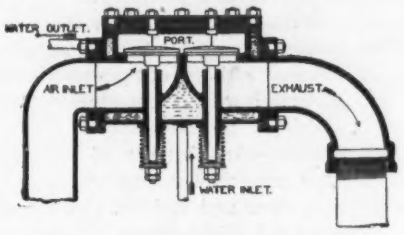


FIG. 3.—ADMISSION MECHANISM.

receives consideration where a few years ago only steam engines would have been thought of.

It is stated that an installation of over 5,000 hp in "Hornsby-Akroyd" oil engines is now being made by the De La Vergne Company.

Lever Switches.

The General Electric Company has recently developed a line of knife blade switches to be known as "D—12" lever switches. They are of simple construction. Sweated joints have been eliminated so far as practicable, and such joints as are sweated are reinforced by other means of fastening. Similar parts of switches of the same capacity are made interchangeable, and the workmanship throughout is of a high grade. The cross bars are made of selected black fibre secured firmly to the blade, while the handles are of hard wood stained black and polished, and firmly attached to the cross bars by heavy studs and insulated nuts. In order to insure very low rise in temperature, the contact clips are generously proportioned from hard-drawn spring copper securely pinned and soldered into the clip blocks, and the hinge clips are provided with large and substantial spring washers which serve to maintain good contact by compensating the slight wear incident to long continued use. These spring washers are provided with positively locked nuts so that contacts are prevented from working loose even in the most severe service. Hard drawn copper is used in the construction of the blades.

Switches of this type are furnished with connections either for enclosed fuses of the National Electrical Code standard or link fuses. Single and double-pole, double-throw switches have offset fuse connections, necessitating but one set of fuses. The

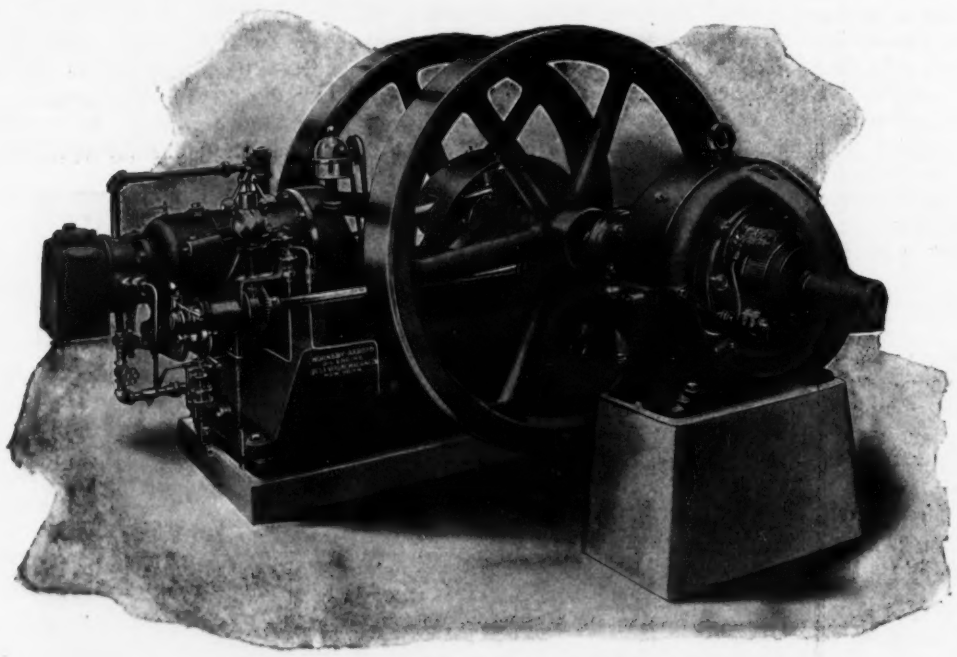


FIG. 1.—DIRECT-CONNECTED OIL ENGINE-GENERATOR SET.

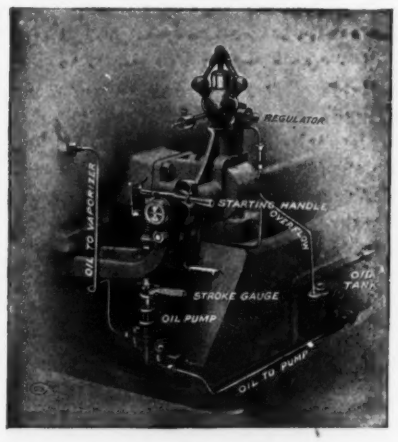


FIG. 2.—GOVERNOR MECHANISM.

standard switch for enclosed fuses is so arranged that when the switch is open the fuses are on the load side. This arrangement

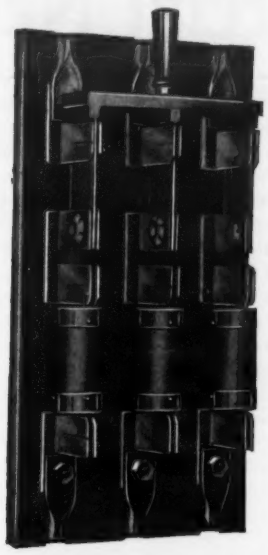


FIG. 1.—SWITCH EQUIPPED WITH THREE FUSES.

can be varied, however, and the switches can be furnished so arranged that when open, the fuses will be between the switch

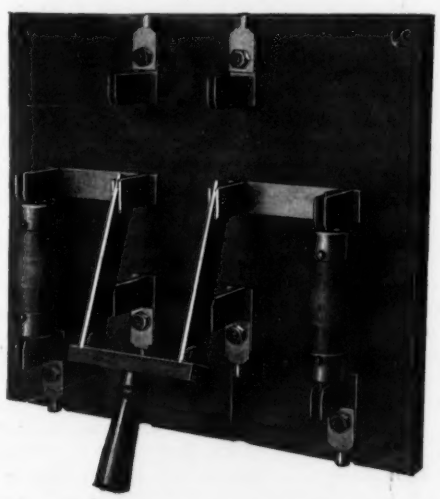


FIG. 2.—SWITCH EQUIPPED WITH TWO FUSES.

and the service. These switches are made in single, double, triple and four-pole types.

Fuel Consumption of Oil Engines.

The accompanying table and diagram are taken from a report on a 225-hp Diesel oil engine, installed at the plant of the Kimberly & Clark Paper Company, Kimberly, Wis., recently tested by the Sargent Engineering Company, Chicago, Ill.

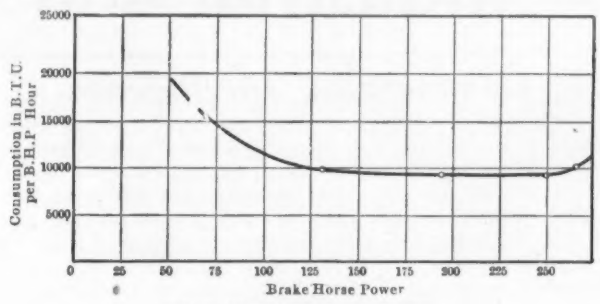
It will be noted from both the table and the diagram that the tests include five conditions of load; one-quarter load, one-half, three-quarters, full load and 16 per cent overload above rating.

The curve indicates two extraordinary features of the Diesel engine: First, its low heat consumption per brake horse-power-hour, and second, the remarkable manner in which the fuel consumption follows the load from 25 per cent load factor and especially from 50 per cent to full load.

It is well known that a similar curve plotted for a steam engine would be a very rapidly ascending curve as the load falls off, due to the large heat loss in the boilers, piping and cylinder condensation which are practically constant, no matter what the load.

Referring to the table, the final data show the fuel cost of this plant, with crude oil at 3.64 cents per gallon, to be at full load 23 cents per 100 brake hp-hour and 34 cents per 100 kw-hours.

The Diesel engine is sold under a guarantee to deliver 100 brake hp-hours on 8 gallons of crude or fuel oil, and 100 kw-hours on 12½ gallons, which would cost, with oil at 3.64 cents



HEAT CONSUMPTION CURVE.

per gallon, 29.12 cents for 100 brake hp-hours and 45½ gallons for 100 kw-hours, respectively. Therefore, it appears that the guarantee has been exceeded by over 26 per cent.

It is only fair to the reader to state that 3.64 cents per gallon

	¼ load.	½ load.	¾ load.	Full load.	Over load
Length of run in hours...	1.	2.	3.	4.	.75
Brake-horsepower	68.15	133.7	194.9	242.7	263.8
Lbs. of fuel oil used per B.H.P.-hour	.776	.493	.469	.464	.516
Lbs. of fuel oil used per kilowatt-hour	1.29	.778	.718	.69	.77
Percentage B.T.U. in water jacket	18.2	20.	19.5	24.3	26.
Percentage B.T.U. in exhaust radiation and engine friction	65.	53.4	52.7	47.6	48.7
Perc'ge B.T.U. in B.H.P.	16.8	26.4	27.8	28.1	25.3
Gallons oil per 100 B.H.P. hours	10.6	6.7	6.4	6.3	7.
Fuel cost of 100 B.H.P.-hrs. in cents with oil at 3.64 cts. per gal.....	38.6	24.5	23.3	23.	25.6

is considerably above the price paid for crude or fuel oil in many parts of the country. Many oil engine plants receive their fuel delivered for from 2¼ to 2¾ cents per gallon.

Exhibits at the Convention of the Illinois State Electrical Association.

On the occasion of the convention of the Illinois State Electrical Association, which was held in the Leland Hotel, Springfield, Ill., September 19 and 20, several interesting exhibits were made by manufacturers of and dealers in electrical supplies.

The General Electric Company exhibited electric cooking apparatus and demonstrated its use. A 4-amp., direct-current, series magnetite arc lamp and Gem lamps of various sizes were also interesting features of the exhibit.

The Westinghouse Electric & Manufacturing Company exhibited a new type of prepayment meter. The meter was wired up so that all of the current for operating the arc lamps forming part of the exhibit passed through it. Ceiling and desk fans and portable measuring instruments were also exhibited.

The Nernst Lamp Company showed several lamps of various sizes.

The Bryan-Marsh Company exhibited high-efficiency lamps. Both tantalum and metallized filament lamps were shown.

The exhibit of the Electric Service Supplies Company consisted of electric railway line apparatus, Dietrick & Jordan armature coils for street railway motors, rail bonds, Victor high-tension insulators, Dossert joints and Garton-Daniels lightning arresters.

A series alternating arc equipment in operation, together with prepayment meters and transformers, formed the exhibit of the Fort Wayne Electric Works.

The W. J. Barr Electric Manufacturing Company exhibited the Eureka electric iron.

The Gregory Electric Company showed in operation a one-half horse-power Century motor belted to an Erwin triplex pump. A vertical motor of the same size was exhibited in connection with an Erwin centrifugal pump.

The Atlas Railway Supply Company had on exhibition the Atlas rail joint, together with the Bruley steel fence post, which is especially adapted for right-of-way fences for interurban railways.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The generally favorable conditions of trade continue to hold good, although some little diminution of activity and of values appears attributable to the bad weather of the past week affecting crops and interfering more or less with the retail merchants, besides prolonging in some degree the holiday season, which is usually brought to a sharp close with cold weather. Indications are, however, that with the departure of the relaxing warm weather experienced all over the country, retail trade is becoming much brisker, and that with the crops fairly well gathered in, the farmers are beginning to put in circulation the money that has been so liberally poured into the agricultural sections of the country. Every department of the mechanical and electrical trade makes good reports, and the trouble, if any, appears to be an inability to fill orders rather than to secure them. Basic industries are all working at high pressure and pig iron for prompt delivery has been in very strong demand, while the railways are giving heavy orders again for steel rail, as well as for steel cars and other equipment. Copper has remained steady at high quotations, and, as our own Construction News department shows, the amount of new work coming into sight is still extraordinarily large, all branches increasing their requirements for the metal. Business failures for the week ending Sept. 20 numbered only 171 as compared with 173 in the corresponding week of 1905, with 203 in 1904, 185 in 1903, and 172 in 1902; these figures, in view of the increase of business, indicating a much smaller percentage. Bank clearings for the week were 1.2 per cent heavier than in the previous week, and not less than 25 per cent above the corresponding week last year. There has been some little apprehension in commercial circles as to the higher rates for money, which it is thought might possibly operate against the prosperity of trade. Copper quotations for the future remain strong, and the large producers state that they have no difficulty in selling all the copper available at a price of 19½c. for delivery during the next four months. In fact, it is predicted, but hoped that the prediction will not be realized, that the price will be in the vicinity of 20c. within a few weeks. The building boom continues throughout the country, and this brings with it a corresponding demand for all classes of electrical apparatus and service, so that manufacturers, jobbers and supply houses report an excellent inquiry for all lines of material.

POWER AT PRIEST RAPIDS.—Mr. J. A. Young, of Seattle, formerly of the Spokane Canal Company of Seattle, Wash., announces that he and his associates, who include a number of Seattle's leading citizens, have formed a company to carry through an irrigation scheme for that district. The company is to be known as Hanford Irrigation & Power Company, named after Judge Hanford, who is one of the principal members of the company. The company is incorporated for $250,000. The land to be irrigated is chiefly in the northeastern part of Benton county, west of the Columbia. It is the plan of the corporation to put up a big power plant at Priest rapids and to develop 50,000 horse-power there. This power is to be utilized in the big irrigation scheme and will be used in pumping the water from the Columbia river to irrigate the lands for a radius of 50 miles. Contracts have been arranged already and work is to begin this autumn. Mr. Young expects to have a plant sufficient to irrigate 25,000 acres. The matter of irrigating from the Columbia river has always been a difficult problem. The land along the river, which is located in such a position as to make irrigation fruitful, is so much higher than the river that it is a difficult matter to raise the water. Several pumps have been tried, but it appears that none have worked with unqualified success. This is the first attempt to construct a big power plant there for that purpose, and Mr. Young and his associates believe it will be an unqualified success.

THE MONTREAL LIGHT, HEAT & POWER COMPANY have recently contracted with the Canadian Westinghouse Company, Ltd., for a large addition to their power equipment. The apparatus is for their new Soulanges Canal power station on the St. Lawrence River. The equipment consists of three Westinghouse 3,750-kw revolving field alternating current, two-bearing generators connected to water turbines. These generators are 60-cycle, 4,000 volts, three-phase, operating at 225 revolutions per minute. There are also two Westinghouse 150-kw direct current, 125-volt exciter units, and 2,500-kw oil-insulated, water-cooled transformers to the number of thirteen are an important part of the equipment. Seven of these transformers will be used for raising the voltage at their generating station from 4,000 to 44,000 volts, and six of them will be used at the lowering end of the transmission line, stepping down the voltage from 44,000 to 12,000. The generators and exciters will be controlled by motor-operated rheostats and the complete switchboard apparatus, which the Canadian Westinghouse Company are furnishing for both the main and sub-stations, will involve the latest type of electrical control, representing the highest development of switchboard apparatus. This contract is among the largest recently placed in the Canadian field, and was awarded to the Canadian Westinghouse Company after sharp competition.

NATIONAL AIR BRAKE EQUIPMENTS.—The National Brake & Electric Co., of Milwaukee, Wis., reports the following recent orders for its air brake equipments: Pensacola Electric Terminal Railway Co.; Chicago City Railway Co., Chicago, Ill.; United Railways of San Francisco, San Francisco, Cal.; Oakland Transit Co., Oakland, Cal.; Spokane Traction Co., Spokane, Wash.; Metropolitan Street Railway, Dallas, Tex.; Rapid Transit Railway Co., Dallas, Tex.; Dallas Consolidated Railway Co., Dallas, Tex.; San Diego Electric Railway Co., San Diego, Cal.; Worcester Consolidated Street Railway Co., Worcester, Mass.; Michigan United Railways, Kalamazoo, Mich.; Twin City Rapid Transit Co., Minneapolis, Minn.; Chattanooga Railways Co., Chattanooga, Tenn.; York Street Railway Co., York, Pa.; Memphis Street Railway Co., Memphis, Tenn.; Birmingham Railway Light & Power Co., Birmingham, Ala.; Knoxville Railway & Light Co., Knoxville, Tenn. All the orders for these roads have been taken within the last thirty days, during which time this apparatus has been on the market, and they approximate four hundred equipments.

THE YUKON CONSOLIDATED GOLDFIELDS CO., LTD., have contracted with the Canadian Westinghouse Company for the following electrical apparatus to be used in gold dredging in the Yukon Territory: Three 100-hp, 3-phase, 60-cycles, 400-volt motors; three 15-hp, 3-phase, 60-cycles, 400-volt motors; three 50-hp, 850 r.p.m., 3-phase, 60-cycles, 400-volt, constant speed induction motors; three 30-hp motors; three 20-hp, 1,120 r.p.m. motors; three 15-hp, 850 r.p.m. motors; three 7½-hp, 1,700 r.p.m. motors; nine 75-kw, oil-insulated, self-cooling transformers; two 625-kw, 3-phase, 60-cycles, 2,200-volt, 415 r.p.m., alternating-current generators, and two 17-kw exciters for same; one 4-panel switchboard for controlling above; four 250-kw, oil-insulated, oil-cooled transformers and four 200-kw transformers, same type.

OUTPUT OF BELL TELEPHONES.—The American Telephone & Telegraph's instrument statement for August and eight months ended Aug. 31 compares as follows.

August.	1906.	1905.	1904.	1903.
Gross output	158,758	127,928	98,272	63,565
Returned	56,965	58,390	46,540	46,136
Net output	101,793	69,538	51,732	17,429
Eight months ending Aug. 31:				
Gross output	1,548,370	1,140,445	770,304	732,823
Returned	486,057	405,911	336,572	325,393
Net output	1,062,313	734,534	433,732	407,430
Total outstanding ..	6,760,571	5,215,098	4,213,249	3,557,750

This represents roughly 3,380,285 stations.

LANGSTADT-MEYER.—The copartnership of Langstadt & Meyer, electrical engineers and contractors of Appleton, Wis., has been succeeded by the Langstadt-Meyer Construction & Supply Company, a corporation with a capital stock of $50,000. Mr. H. W. Meyer is president, Mr. A. C. Langstadt, vice-president, and Mr. A. H. Meyer, secretary and treasurer, with offices at Appleton, Wis. The company will make a specialty of building and equipping electric and other power plants, and will also do a jobbing business in electrical supplies of every kind.

THE RUST BOILER COMPANY, of Pittsburg, has secured the order for the boilers for the U. S. Steel Corporation's new plant at Cary, Ind., the order being for sixteen 400-hp Rust water-tube boilers.

ALLIS-CHALMERS ELECTRICAL ORDERS.—The Allis-Chalmers Co., of Milwaukee, Wis., report the following recent orders in their electrical department: National Conduit & Cable Company, Hastings-on-Hudson, N. Y., 150-hp induction motor, 4-panel switchboard. J. A. Fay & Egan Co., Cincinnati, Ohio, two 5-hp motors, 7½-hp motor, 10-hp motor, 30-hp motor. Murray Engineering Company, Washington, D. C., 75-kw generator, one 4½-hp, one 5-hp and two 25-hp direct-current motors. Minneapolis Steel & Machinery Company, Minneapolis, Minn., 45-kw generator, 30-hp motor. C. H. Stieff, Baltimore, Md., 150-kw E. T. generator, 12½-kw belted exciter. Patapsco Electric & Manufacturing Company, Ellicott City, Md., two 300-kw kodak generators, two 17½-kw exciters. Erber & Hopkins Co., for Jeffrey Manufacturing Company, Columbus, Ohio, two 5-hp motors, two 9-hp motors. American Cigar Box Lumber Company, Johnston City, Tenn., 10-kw generator, 25-kw generator, two 10-hp motors, 7½-hp motor, 3-hp motor and switchboard. National Starch Co., Waukegan, Ill., 5-hp motor, twelve 10-hp motors, twenty-seven 20-hp motors, two 15-hp motors, 30-hp motor. Empire Engineering Corporation, Moreau Junction, N. Y., four 4-kw generators and 4-in. x 4-in. American Blower Engine Sets, with switchboards, wiring material and incandescent lamps. Savannah Lumber Company, Savannah, Ga., 500-kw turbo-generator set, 15-kw engine exciter set. Flatbush Gas Company, Brooklyn, N. Y., 750-kw turbo-generator set. Jamestown Woolen Mills, Jamestown, N. Y., 500-kw turbo-generator set. Corn Products Co., Waukegan, Ill., 800-kw generator, 20-kw exciter. Wheelwright Construction Company, Rexbury, Idaho, 50-hp motor. East Side Packing Company, East St. Louis, Ill., 50-kw generator, 4-kw balancer set, 35-hp motor, three 10-hp motors, two 25-hp motors, 4-panel switchboard. Irwin Auger Bit Company, Wilmington, Ohio, six 15-hp motors, 20-hp motor, 10-hp motor, 7½-hp motor. E. M. Deane & Co., Sedalia, Mo., 5-panel switchboard.

ALLIS-CHALMERS EQUIPMENTS.—The Daly Judge Mining Company, of Park City, Utah, has let a contract for furnishing a 12-in. x 24-in. Reynolds Reliance Corliss engine of the belted type to the Allis-Chalmers Co., of Milwaukee. The new unit will operate at a speed of 130 r.p.m., non-condensing, under a steam pressure of 110 lbs., and will be belted to a countershaft running concentrating tables and an electric generator. The Somerset Coal Company, of Baltimore, Md., recently ordered for installation at the Jenner Mines, Boswell, Pa., two Allis-Chalmers heavy-duty, cross-compound engines for direct connection to 300-kw, alternating-current generators. The new units will be operated at a speed of 150 r.p.m., condensing under a steam pressure of 150 lbs. The Sioux Falls Electric Light & Power Company, of Sioux Falls, S. Dak., recently purchased a 14-in. x 24-in. Reynolds Reliance Corliss engine, built by the Allis-Chalmers Co. The new unit, which is being furnished without shaft, flywheel or outer bearing, will be used to make up one side of a twin engine, the other side of which was purchased over a year ago from the same builder. The completed unit will be carried in reserve as the present power facilities used by the Sioux Falls Company comprise water turbines. The unit will be operated at a speed of 150 r.p.m., non-condensing, under a steam pressure of 130 lbs., and bolted to a shaft for operating an electric generator.

POWER & MINING MACHINERY COMPANY, of Cudahy, Wis., report among numerous other orders of mining machinery two electrically driven converter stands for the Selby Smelting & Lead Company, of South San Francisco.

Financial Intelligence.

THE WEEK IN WALL STREET.—With a continuous activity in the stock market there has been a perceptible falling off in the general prices of securities for various reasons. The rates for money have continued abnormally high and the large importations of gold have apparently done little to lessen the extravagant charge for loans. While the demand for money is undoubtedly caused as much by the legitimate requirements of an immense and unparalleled commerce as by the speculations in Wall Street, there is a tendency abroad to attribute the American hunger for gold almost entirely to the latter cause, with the result that our situation is viewed somewhat cynically and commented upon rather harshly by many European critics. In this country there is also a tendency at the present moment to deprecate the land boom which has made itself felt all over the country and has converted a great deal of fluid into fixed capital, accompanied also in the larger cities by the destruction of large amounts of property and buildings useful and fit for occupancy, which in the aggregate must represent a loss as large as that caused by the San Francisco disaster. Other disquieting causes at the present moment are the serious political troubles in Cuba, involving the necessity f American intervention, and more nearly at home the dominance of such spirits as Hearst in politics. In fact the probability that the "journalist of discontent" may become the Democratic nominee for Governor of New York State had a marked effect in the decline of quotations during the earlier part of this week. Over against all this, however, is the undeniable fact of well-maintained national prosperity, redundant crops and the active employment of labor in every branch—a state of affairs involving, it is believed, the maintenance of good conditions for some time to come, with occasional downward fluctuations by way of rest and relief. Transactions on the New York Stock Exchange last week involved 3,200 shares of General Electric at quotations around 166 to 166½; but the deals in Westinghouse Electric were practically negligible. Western Union Telegraph was moderately active with deals in 2,200 shares, but there was a marked decline during the week, from 90⅝ to 86. All the traction securities were more or less weak, in sympathy with the political situation. There was little doing in American Telephone & Telegraph, with prices fairly steady at 138. The Mackay Companies were also steady at a low range, the common being 72 to 73 and the preferred 71 to 72. Subjoined are the quotations of September 25:

NEW YORK

	Sept. 18	Sept. 25		Sept. 18	Sept. 25
Allis-Chalmers Co.	18	14⅜	General Electric	166	165
Allis.Chalmers Co. pfd.	44⅛	40½	Hudson River Tel.	...	...
American Dist. Tel.	25	25	Interborough Rap. Tran.	...	...
American Locomotive	76⅛	72¾	Mackay Cos.	72⅜	72⅜
American Locomotive pfd.	113⅜	112	Mackay Cos pfd.	70⅛	71
American Tel. & Cable	91	90	Marconi Tel.	...	...
American Tel. & Tel.	134	138	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	80⅛	76	N. Y. & N. J. Tel.	...	...
Electric Boat	15	15	Western Union Tel.	89¾	86
Electric Boat pfd	60	60	Westinghouse com.	151	148
Electric Vehicle	12	12	Westinghouse pfd.	...	...
Electric Vehicle pfd.	18	18			

BOSTON

	Sept. 18	Sept. 25		Sept. 18	Sept. 25
American Tel. & Tel.	136	139	Mass. Elec. Ry. pfd	73½	72
Cumberland Telephone	...	...	Mexican Telephone	5	...
Edison Elec. Illum.	...	236	New England Telephone	129	129
General Electric	...	...	Western Tel. & Tel	...	...
Mass. Elec. Ry.	20	...	Western Tel. & Tel. pfd.	88	87

PHILADELPHIA

	Sept. 18	Sept. 25		Sept. 18	Sept. 25
American Railways	51¼	51¾	Phila. Electric	8⅝	8⅜
Elec. Co. of America	11¼	11⅜	Phila. Rapid Trans.	29⅛	29¾
Elec. Storage Battery	70	70	Phila. Traction	99	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Sept. 18	Sept. 25		Sept. 18	Sept. 25
Chicago City Ry.	165	160	National Carbon	85	84½
Chicago Edison	...	...	National Carbon pfd.	119	119
Chicago Subway.	52	...	Union Traction	...	...
Chicago Tel. Co.	119	...	Union Traction pfd	...	..
Metropolitan Elev. com.	26	26			

AMERICAN SMELTING REPORT.—The annual report of the American Smelting & Refining Company shows net earnings for the fiscal year, ending April 30 last, of $3,101,368, an increase of $1,262,546, 14.2 per cent over those of 1905. This showing is made despite the deduction from the year's profits of $1,766,681 paid for new plants and properties, betterments, repairs and improvements, and without taking into account the earnings from the mining properties of the company or the earnings on the stocks of the American Smelters Securities Company, the United States Zinc Company and the United Lead Company, which it holds, nor the income from the use of patents. Out of this income dividends of $6,750,000 have been paid on the $100,000,000 of capitalization. This sum includes an increase of $750,000 in the distribution on the common stock, leaving a surplus for the year of $2,024,054, compared with $1,618,911, for 1905. The addition of the year's surplus to the undivided surplus account brings the total of that sum up to $10,482,774, about one-half of which is represented by cash in banks and trust companies and other quick assets.

THE NEW ENGLAND INVESTMENT & SECURITY COMPANY, which has taken over the electric railway lines of the New York, New Haven & Hartford Railroad, controlled through the Consolidated Railway, has issued in payment to the Consolidated promissory notes and its outstanding capital $10,000,000 preferred and $10,000,000 in common stock. The Consolidated guarantees 4 per cent dividends on the preferred shares. It is understood that this company will not take over any trolley lines outside of Massachusetts.

THE CAMBRIDGE ELECTRIC LIGHT COMPANY, Cambridge, Mass., reports for the year to June 30 gross earnings $264,732, net $133,390, and a surplus of $65,339 after dividends.

KANSAS CITY FIGURES.—According to the pamphlet report just issued to the stockholders, the net income of the Kansas City Railway & Light Company in the fiscal year ended May 31 was $921,700 an increase of $248,000 over the amount in the preceding year. After the payment of 5 per cent on the $9,521,800 of preferred stock outstanding there was a balance of $445,000, equal to about 4.6 per cent of common stock outstanding. The consolidated report of the railway and lighting companies for the fiscal period compares as follows:

	1906.	1905.
Gross earnings	$5,153,168	$4,449,133
Operating expenses	2,596,539	2,235,260
Net earnings	2,556,629	2,213,873
Other income	9,671	16,589
Gross income	2,566,300	2,239,462
Deductions from income	1,644,524	1,556,863
Net income	921,776	673,599

The income account of the year ended May 31 is as follows:

CREDIT.

Interest from subsidiary companies		$611,334
Dividends from subsidiary companies—		
Street railway companies	$616,805	
Electric light companies	304,970—	921,776
Total		$1,533,119

DEBIT.

Interest on funded and floating debt	$611,343
Net income	921,776
Dividends	476,105
Surplus for year	445,671
Retirement of 50 Corrigan street railway bonds	55,000
Balance	390,671
Surplus at beginning of year	266,680
Surplus at close of year	657,351

The balance sheet as of May 31 is as follows:

ASSETS.

Stocks, improvement gold notes and other securities		$28,456,884
Metropolitan Street Railway Company advances		2,910,429
Kansas City Electric Light Company advances		636,079
Accounts receivable		71,024
Cash		142,110
Treasury stock—		
Preferred	$2,978,200	
Common	2,864,420—	5,842,620
Treasury bonds		1,875,000
Total		$39,934,146

LIABILITIES.

Preferred stock	$12,500,000
Common stock	12,500,000
First lien bands	9,200,000
Collateral notes (three-year)	3,000,000
Bills payable	1,957,769
Dividends (paid June 1)	119,026
Surplus	657,351
Total	$39,934,146

In his report to the stockholders, Bernard Corrigan, president of the consolidated company, says the year demonstrated the increasing earning power of the properties. The street railways carried 11,073,100 more passengers than in the preceding year, a gain of 14.34 per cent. The business of the lighting company shows an increase of 43.62 per cent. The Kansas City stocks sell in the Chicago market at about 58 for the common and 88 for the preferred.

BELL TELEPHONE DIVIDENDS.—It is possible, remarks the *Wall Street Journal*, that the action of the directors of the Colorado Telephone Company in increasing the rate of that company's dividend from the 6 to 7 per cent basis per annum may be indicative of a policy of more liberal dividends for the stockholders of the other Bell companies. The American Telephone & Telegraph Company holds nearly 53 per cent of the stock of the Colorado company, so that it was necessary for its representatives to sanction the increase of the rate. In the following tabulation are shown some of the statistics of a few of the more prominent Bell companies, that may bear on this matter of increased dividends:

Company.	Available for div. Dec. 31, '05.	Dividends paid in. 1905.	Dividends increased by 1% requires
Colorado	$396,432	$326,664	$381,108
Bell of Buffalo	555,118	363,000	423,500
Cumberland	1,359,284	940,891	1,344,768
Pacific States	1,603,000	995,652	1,120,000
Bell of Phila.	1,278,562	899,068	1,119,510
N. Y. & N. J.	1,446,016	1,034,150	1,388,800

The Buffalo Bell pays 6 per cent; the Cumberland, 7; the Pacific States, 6; the Philadelphia Bell, 6, and the New York & New Jersey, 7.

WESTERN TELEPHONE AND TELEGRAPH.—It is noted in advices from Boston that since the close of the last fiscal year of the Western Telephone & Telegraph Co., on January 31, three of its four constituent companies have authorized increases in their capital stock, and one of these companies is preparing to issue new stock at once. The four constituent companies of the Western Telephone Co. are the Southwestern Telegraph & Telephone Co., Northwestern Telephone Exchange Co., Wisconsin Telephone Co., and Cleveland Telephone Co. The aggregate amount of stock of these four companies issued at the close of the last fiscal year was $22,111,100. The increases in stock authorized since January 31 will bring the total authorized to $49,000,000. The only one of the four sub-companies which has not authorized an increase is the Cleveland Telephone Co. The Wisconsin Telephone Co. is the first of the three companies to issue new stock and on July 31 offered to stockholders $4,516,600 of new stock, payable half Sept. 15 and half Feb. 15 at the ratio of one and one-half shares of new for each share of old. The Western Telephone as the owner of 82.2 per cent, and the American Telephone as the owner of 16.7 per cent of its capital stock will take approximately $3,700,000 and $755,000 respectively of the new stock.

MEXICAN LIGHT & POWER.—The Mexican Light & Power Co., Ltd., reports that the earnings of the company during the first six months of the present year, in Mexican currency, were in detail:

January	$281,634
February	279,688
March	285,570
April	299,295
May	295,220
June	313,426
Total gross earnings	$1,754,833
Operating expenses	722,330
Net earnings	*1,032,503

*Equivalent to about $516,000 in gold.

Of the operating expenses ($722,330), $320,000 was due to the use of steam power; while the maintenance charges amounted to $111,772, all expressed in Mexican currency.

WESTINGHOUSE AIR BRAKE.—The general prosperity of the Westinghouse industries is reflected in the following special dispatch from Pittsburg of September 6: "The Westinghouse Air Brake Company directors held their quarterly meeting here to-day and declared an aggregate dividend for the quarter of 7½ per cent, or at a rating of 30 per cent for the year. For some reason the action of the meeting was not made known until nearly midnight, but there appears to have been a leak some days ago, which would explain the jump in Westinghouse Air Brake, especially of to-day, when 151 was bid, with but few sales. Three separate dividends were declared at the meeting of the board. The first, which was designed as a "regular quarterly dividend," was 2½ per cent, and then came an "extra" dividend of 2½ per cent. These two dividends were followed by a "special" dividend of 2½ per cent.

POWER IN IDAHO.—Five million dollars of bonds have been voted by the stockholders of the Lewiston & Southeastern Electric Railway and the Salmon River Power Company. The bonds have all been placed. Actual construction, it is understood, will begin within 90 days. The contract has been let to the Schofield Company, of Philadelphia. The bonds voted are in two issues, one of $2,000,000 and the other of $3,000,000, the former for development of electric power and the latter for construction of the railway. A tunnel 30 ft. high and 18 ft. wide is to be driven more than half a mile through a mountain.

THE PORTLAND ELECTRIC DEAL.—All the stock and bonds of the Portland Electric Co. to be issued at present, amounting to $1,000,000 5 per cent 20-year first mortgage bonds and $500,000 preferred and $1,000,000 common stock, have been placed. The Portland Electric Co. was recently formed to take over the property and the business of the Portland Light & Power Co. and the Consolidated Electric Co. The Portland Electric Co. was underwritten by A. B. Leach & Co., who have placed the new securities in the past two months.

KANSAS CITY EARNINGS.—The Kansas City Railway & Light Co. reports for July as follows:

	1906.	1905.	1904.
July gross	$469,975	$417,291	$365,379
Expenses	233,561	242,347	207,112
July net	$236,414	$174,944	$158,267

Surplus after charges for July, 1906, was $92,954.

SALE OF DANSVILLE PLANT.—The Gas & Electric Development Company, of Philadelphia and New York, has effected a sale of the Dansville Gas & Electric Company, of Dansville, N. Y., to Philadelphia parties. The plants will be overhauled and operated for the new owners by the Gas & Electric Development Company. New engines and dynamos are to be installed.

TRI-CITY EARNINGS.—The Tri-City Railway & Light Company shows gross for June, $130,510, and net, $52,496. The net for three months was $131,293, an increase of $8,851 over 1905.

THE WORCESTER ELECTRIC LIGHT COMPANY, Worcester, Mass., reports for the year to June 30 gross earnings $306,019, net $160,995, and a surplus after dividends of $114,414, comparing with $104,791 for the previous year.

THE MEXICAN TELEGRAPH COMPANY reports for the third quarter gross traffic receipts of $154,500, net income of $124,250, a balance of $140,250, dividends of $71,752 and a surplus of $68,498. The Central & South American Telegraph Company reports gross of $358,000, a total net income of $248,750, dividends of $115,884 and a surplus of $132,866.

HYDE PARK ANNUAL REPORT.—The Hyde Park, Mass., Electric Light Company has made its annual report as follows for the year ended June 30:

	1906.	1905.
Gross earnings	$108,265	108,620
Expenses	66,025	65,212
Net earnings	42,240	43,408
Dividends	23,000	23,000
Surplus	19,240	10,408

WESTERN ELECTRIC LOAN.—The Western Electric Company has borrowed $1,000,000 of Curtis & Sanger, of Boston, on year notes drawing 6 per cent, dated Sept. 17, 1906, interest payable semi-annually. Curtis & Sanger have sold about two-thirds of the issue. Notes are offered at par and interest. The Western Electric factories in Chicago and New York are literally swamped with business and cannot keep up with their orders.

ELECTRIC COMPANY OF AMERICA.—Advices from Philadelphia state that the earnings of the Electric Company of America continue to show increases. If, after the customary conservative chargings off on the subsidiary properties are made, the company should show for 1906 a gain equal to that of its best gain in any recent year, there might be shown $500,000 net for the capital stock. This would be equal to 10 per cent on the present capital, it having been increased last year from $4,078,780 to $5,000,000.

WESTINGHOUSE STOCK.—It is strongly reported in Wall Street that the Westinghouse Electric & Manufacturing Company is to make a new issue of capital stock, though it is understood the directors have not yet determined upon the amount of the issue or the conditions on which it will be sold. "Rights," however, are spoken of as assured. The company is now doing a business of about $40,000,000 a year. Last March the authorized common stock of the company was increased from $21,000,000 to $50,000,000 to provide for the conversion of the convertible bonds, of which $20,000,000 were authorized and $15,000,000 issued early in the present year, as well as to provide for future capital requirements.

NEW ENGLAND LIGHTING REPORTS.—The Fall River Electric Light Company and the Salem Electric Lighting Company have filed the following reports, for the year ended June 30, 1906, with the Massachusetts gas commissioners:

FALL RIVER ELECTRIC CO.

	1906.	1905.	Increase.
Gross earnings	$223,599	$205,473	$27,126
Net earnings	96,651	74,418	22,233
Dividend (8½%)	39,750	24,500	15,250
Surplus	56,901	49,918	6,983

SALEM ELECTRIC LIGHTING CO.

Gross earnings	$153,273	$138,267	$15,006
Net earnings	61,049	54,738	6,311
Dividends (8%)	22,000	20,625	1,375
Surplus	39,049	34,113	4,936

TRI-CITY RAILWAY & LIGHT.—The directors of the Tri-City Railway & Light Company have declared a dividend of 1½ per cent on the company's preferred stock. The application of the company for the listing of its stock is now before the Stock Exchange, and it is expected that the securities will soon be added to the official list. The earnings of the company for the four months ended July 31 were $515,966 gross, $188,844 net, and the surplus, after provision for all fixed charges, was $98,925. These earnings show large increases over the corresponding period of last year. The directors of the company have recently authorized the expenditure of a large amount for improvements. The plans outlined for this year and next call for the expenditure, all told, of about $1,000,000. Provision for these expenditures was made at the time of the consolidation of the several companies, of which the Tri-City Railway & Light Company is a merger.

UNITED STATES TELEPHONE NOTES.—The United States Independent Telephone Company, of Cleveland, has decided to authorize an issue of collateral trust 6 per cent two-year notes and bond to the amount of $2,500,000, in order to meet the demands of the growing business and consequent necessary expansion of the Stromberg-Carlson Telephone Manufacturing Company. The security for these above notes is conservatively estimated at $5,000,000, or twice the amount of notes. This security is deposited with the Rochester Trust and Safe Deposit Company as trustee under the indenture. The terms of the subsequent agreement provide for the payment of 50 per cent of the amount allotted, on allottment. The remaining 50 per cent is to be payable after thirty days upon giving of five days' notice of each call. The circular on the subject explains that when the original bond issue of $17,000,000 was floated the amount subscribed was only $13,500,000. This was not enough to meet the financial demands of the company in full and the present note issue is the result.

DIVIDENDS.—Directors of the Pacific States Telephone Company have declared a quarterly dividend of 1¼ per cent, payable Oct. 15. The dividend covers the quarter ending Sept. 30. The directors of the Bell Telephone Co., of Philadelphia, have declared a regular quarterly dividend of 1½ per cent, payable Oct. 15. The Washington Power Company, of Spokane, has declared a quarterly dividend of 1¾ per cent. Directors of the Westinghouse Electric & Manufacturing Co. have declared the regular quarterly dividend of 2½ per cent on its preferred assenting and non-assenting stocks, payable Oct. 10. The directors of Electric Storage Battery Company have declared the regular quarterly dividend of 1¼ per cent on both preferred and common stocks, payable Oct. 1. The National Carbon Company has declared a dividend of 1 per cent. on common, payable Oct. 15. Manning, Maxwell & Moore, Incorporated, has declared a quarterly dividend of 1½ per cent., payable October 1. The International Nickel Company has declared a quarterly dividend of 1½ per cent on the preferred stock, payable November 2. The directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable October 6. The directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent, payable October 13. The directors of the United States Long Distance Telephone Company have declared a quarterly dividend of 1½ per cent on the preferred stock, payable October 10, and a quarterly dividend of 1 per cent on the common stock, payable October 1. The Toledo Home Telephone Company has declared the regular quarterly dividend of 2½ per cent, payable October 20. The United Gas Improvement Company, of Philadelphia, has declared a quarterly dividend of 2 per cent—one dollar per share—on the preferred stock, payable October 15.

WESTINGHOUSE IN RUSSIA.—A circular issued in France by the Societe Westinghouse Electrique de Russie, says: "Notwithstanding the unrest, there is considerable industrial activity in Russia at the present time. The import duty on electrical apparatus has been increased to so high a figure that importation is made almost prohibitive, and whereas in former years more than one-half of the electrical apparatus used came from abroad, a great impetus to the home industry should now result." This company has a share capital issued of 20,000,000 francs, and a debenture capital issued of 14,000,000 francs, bearing interest at the rate of 5 per cent. The board of directors is composed of George Westinghouse, president; E. Dejardin-Verkinder, vice-president of the Societe Generale, of Paris, and J. H. Lukach, managing dirctor of the Traction & Power Securities Company, Limited, vice-president, and the Marquis de Frondeville, vice-president of the Banque de l'Union Parisienne, T. Lombardo, managing director of the Banque de Nord, of St. Petersburg, and W. E. Smith, general manager of the Westinghouse Brake Company, of Russia. The company has acquired from the Westinghouse interests all of their patents for Russia relating to electrical apparatus, turbines, gas engines, etc. (exclusive of brakes), and has further acquired from the Compagnie Centrale d'Electricite the electrical works of that company situated at Moscow. An arrangement has been made with the Societe Generale of Paris in respect to the debenture issue, which is to provide the working capital and funds for the acquisition of the works at Moscow. Of the share capital, 7,000,000 francs has been subscribed for in cash to provide reserve working capital, and 25 per cent, i. e., 62.50 francs per share, has been paid up. The remaining 13,000,000 francs of the share capital has been issued as fully paid in return for the "apports" furnished by the Westinghouse interests and the Compagnie Centrale, the Westinghouse interests receiving 11,000,000 francs and the Compagnie Centrale 2,000,000 francs.

GENERAL NEWS.

Construction News.

SANTA ANA, CAL.—The Pacific Electric Railway contemplates the construction of a sub-station in this place.

SACRAMENTO, CAL.—The Sunset Telephone Company has filed a map of its conduit system in this city and has asked for authority to make the necessary excavations to lay the same.

POMONA, CAL.—Messrs. Lobinger, Dreber and Overholtzer was appointed a committee at a recent meeting of the board of trade to confer with the Pacific Electric Heating Company to secure the location of its plant in Pomona.

SAN FRANCISCO, CAL.—The Southern Pacific Railroad Company will begin the work of installing an electric system on its line over the Sierra Nevada Mountains for the purpose of helping the heavy freight trains up the steep mountain grades by means of electric motors.

DURANGO, COL.—The large pipe of the Rockwood Power Company burst on Sept. 17, causing damage, which will require two months or more to repair. The Rockwood Company furnishes electricity to many mines and mills in San Juan County, and many of them will be forced to close down until repairs are made.

ROCKVILLE, CONN.—The Common Council has granted the Stafford Springs Street Railway Company a franchise to lay its tracks in the city of Rockville.

WALLINGFORD, CONN.—The C. F. Wooding Company has been awarded the contract for the joiner and mason work at the electric light station on the Quinnipiac River for $3,940.

ROCKY HILL, CONN.—The question of installing electric lamps at the center is now being agitated, and it is probable that arrangements will be made in the near future with the Hartford Electric Light Company to extend its lines here.

PUTNAM, CONN.—Arrangements are being made by the Consolidated Railway Company for the running of a high-tension wire, for the purpose of transmitting electricity from the company's power station 2½ miles north of this village to Central Village and Taftville, for use of the road now under construction, south of the village.

WASHINGTON, D. C.—The contract for supplying the electrical equipment for the Norfolk Navy Yard has been awarded by the Bureau of Yards and Docks to the Westinghouse Companies, of Pittsburg, for $91,995.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 2, 1906, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; and Norfolk, Va., a quantity of naval supplies, as follows: Schedule 155—Telephone, cable, etc. Schedule 157—Electrical cable, etc. Schedule 158—Galvanometer, conductivity bridge, etc. Schedule 160—Brass and copper wire, phosphor-bronze wire, sheet brass, bronze rod, ingot copper, sheet copper, solder, etc. Applications for proposals should designate the schedules desired by number. H. T. B. Harris, Paymaster General.

MONTBROOK, FLA.—The Florida Electric Company, of Jacksonville, has recently installed an electric light plant with a capacity of 125 lights for the Florida Land Company of this place.

ST. AUGUSTINE, FLA.—A resolution has been passed by the City Council authorizing the clerk to receive bids for lighting the streets for a period of one year with gas or electricity, beginning Oct. 15, 1906. About 86 lamps will be required.

INDIAN SPRINGS, GA.—F. E. Bailey, of Philadelphia, Pa., has purchased the Watkins' mill site at Indian Springs, and is putting in an electric light plant.

HAZELHURST, GA.—It is stated that an election will be held to vote on issuing bonds for constructing water works and purchasing the electric light plant.

WAYCROSS, GA.—George W. Deen and W. M. Tooner have petitioned the Council for a street car franchise in this city. The system will cost at the start about $300,000.

AUGUSTA, GA.—The North Georgia Electric Company has filed application to increase its capital from $5,000,000 to $7,500,000. The company has a franchise to build a line from Atlanta to its power plant near Gainesville.

MILLTOWN, GA.—Frank Lederle, of Atlanta, is making preliminary survey for an electric railway from Milltown to Valdosta, a distance of about 20 miles, for the South Georgia Land & Industrial Company. The water power plant will be constructed at Middletown at a cost of about $250,000.

GAINESVILLE, GA.—The North Georgia Electric Company has purchased the property which joins Wilson Shoals on Chattahoochee River, and it is said that the Wilson Shoals dam will now be completed. The power to be developed will approximate 2,500 hp. W. A. Carlisle is vice-president and chief engineer.

SANDPOINT, IDA.—T. J. Humbird has filed his acceptance of the electric light franchise and will proceed with the installation of an electric light plant.

GREENVILLE, ILL.—The Bond County Telephone Company has increased its capital stock from $6,000 to $18,000.

WASHBURN, ILL.—A. M. Searle, of Chicago, Ill., has been granted a franchise to build, operate and maintain an electric light plant in the village.

ELGIN, ILL.—The Aurora, Elgin & Chicago Railway has announced plans for the improvement of the local lighting system, involving an expenditure of over $125,000.

NEWTON, ILL.—The City Council has granted E. J. Clapp, owner of the local telephone plant, a twenty-year franchise with the privilege of installing telephones on both the metallic and the grounded system.

PEORIA, ILL.—A new turbo-generator set of 1,000-kw capacity has just been installed in the plant of the Peoria Gas & Electric Light Company. The Central Railway Company is also installing two steam turbines in its plant.

TILDEN, ILL.—A company has been chartered here for the purpose of building an electric railway from Belleville to Pinckneyville. T. P. Armstrong, of Coulterville, and Hon. William Stevenson, of Tilden, are among the incorporators.

PERU, IND.—The Home Telephone Company, of this city, is preparing to enlarge its equipment and will soon install a new switchboard of large capacity.

INDIANAPOLIS, IND.—The city will soon place a contract for the installation of an improved insulation board and other needed fixtures for the Gamewell police telegraph system.

FT. WAYNE, IND.—Plans for the new shop buildings of the Ft. Wayne & Wabash Valley Traction Company, to be erected in connection with the new power station, have been completed by the chief engineer. The principal building will be a carpenter and machine shop.

INDIANAPOLIS, IND.—The City Council has passed an ordinance requiring all railroad companies entering the city to provide and maintain electric street lamps at all street intersections. The operation of the ordinance, it is estimated, will save the city upwards of $10,000 a year.

RUSHVILLE, IND.—Bids will be viewed on Oct. 16 by S. G. Gregg, city clerk, for the following apparatus and equipment for the water and light plant. One 225-hp, 4-valve Corliss type engine, a 160-kw, three-phase, revolving field alternator, a four-panel switchboard with necessary instruments and series alternating-current street lighting system, 33 oil type transformers, capacity 6 to 7.5 kw, 83 watt-hour meters, capacity 5 to 75 amperes, 35 series alternating-current enclosed street lamps for commercial use.

FT. DODGE, IA.—The Ft. Dodge Light & Power Company is considering the construction of a dam.

VINTON, IA.—S. S. Lichty and others have secured control of the Benton County & Vinton Telephone Company and will make improvements to the system.

CAMBRIDGE, IA.—A franchise has been granted to W. A. Curtis for an electric light plant, and the materials have been secured. Work will be started without deay.

FT. DODGE, IA.—The Plymouth Gypsum Company has awarded the contract for the electric lighting system for its plant south of the city, to the Dowing Electrical Company.

WEBSTER CITY, IA.—At a special election held in Webster City, Sept. 17, the Boone, Webster City & Interurban Railroad Company was granted the right to operate cars on the streets and to maintain an interurban service between Boone and Webster City.

CARROLLTON, KY.—The City Council has purchased the electric light plant of James F. Jett, and will enlarge same.

LANCASTER, KY.—Burton Vance, of Louisville, has applied to the Council for a franchise to construct an electric railway through the streets of Lancaster for the purpose of making a line from Hubble to Hickman, at the mouth of Sugar Creek.

CORBIN, KY.—Arthur Giesler, 29 Broadway, New York, N. Y., is consulting engineer for the capitalists who propose developing the water power of the falls of Cumberland River about 16 miles from Corbin, the work contemplated will cost about $2,000,000.

BRANDON, LA.—The question of constructing water works and an electric light plant is under consideration here.

LAKE ARTHUR, LA.—Robt. P. Howell, of Lake Arthur, is the chief promoter of the Lake Arthur Ice, Light & Water Works Company. Bids for construction work will be called for in November; probable cost of work proposed, $12,500 to $15,000.

LAFAYETTE, LA.—The City Council has contracted with Spranley & Reed, of New Orleans, for the extension and renovation of the electric light plant and water works, at a cost of $25,400. The contract calls for 8,000 feet of water mains, 92 arc lamps, new boilers, engines, dynamos and arc lighting system. Work will be completed by Jan. 1.

WATERVILLE, ME.—The State Board of Railway Commissioners on Sept. 15 approved the articles of the association of the Augusta, Oak-

land & Waterville Street Railway Company, which will build 18 miles of road. The directors are: Amos F. Gerald and Edwin J. Lawrence, of Fairfield; A. B. Page, of Shawmut, and Cyrus W. Davis, of Waterville. John A. Jones, of Lewiston, is chief engineer.

AUGUSTA, ME.—The State Railroad Commissioners on Sept. 14 approved articles of association of the Rumford Falls & Bethel Street Railway Company to construct, maintain and operate a street railroad in and through Mexico, Rumford, Hanover, Newry and Bethel by electricity or compressed air. The length of the road will be about 30 miles. The capital stock is $120,000. The directors are: Elliott W. Howe, Everett K. Day, Orville J. Gonya, William H. Ray and Dennis J. McCoy, all of Rumford. John A. Jones, of Lewiston, is chief engineer.

RISING SUN, MD.—The Commissioners of Cecil County, at Elkton, have granted the Rising Sun Electric Light & Power Company a franchise to erect poles along the county roads. The company, which has been recently formed, proposes to light the town of Rising Sun.

WINCHENDON, MASS.—The Winchendon Electric Light & Power Company is contemplating the removal of its plant to Harrisville in the near future.

WARE, MASS.—The Ware Electric Company has started its day service as a permanent arrangement, and light and power is available 24 hours every week day.

CHESTER, MASS.—The Chester Electric Light Company has petioned the Selectmen for a location for new poles and wires for the purpose of extending its lighting system.

MIDDLEBORO, MASS.—The electric light committee has recently ordered a 150-kw, three-phase, 1,100-volt generator from the General Electric Company for the municipal electric light plant.

SOUTH FRAMINGHAM, MASS.—A committee has been appointed by the town to consider the purchase of the property of the Edison Company and the Framingham Gas, Fuel & Power Company.

WESTBORO, MASS.—At a recent meeting of the Westboro Gas & Electric Company, George L. Smith was re-elected president, Vincent Goldthwaite treasurer, and Bertram S. Goldthwaite, clerk.

NORTHAMPTON, MASS.—David Barry, superintendent of the Amherst Gas Company has petitioned the selectmen for the privilege of erecting electric light poles and wires on several streets in the town.

LOWELL, MASS.—The Lowell Electric Light Corporation has petitioned the State Board of Gas and Electric Light Commissioners for permission to issue $325,000 additional capital stock, to pay floating debt and to build additions to its plant.

SOUTHBRIDGE, MASS.—The Boston Heat & Power Company has purchased the plant of the Southbridge Gas & Electric Company and will take over the plant Oct. 15. The new company is planning to increase and extend the service in Southbridge and to give an all-night service.

GREENFIELD, MASS.—The Sate Board of Gas and Electric Light Commissioners has authorized the Greenfield Electric Light & Power Company to issue $650,000 additional capital stock to be applied to cancel an equal amount of floating debt incurred in developing the plant of the company, which has lately put in a new lighting system.

PITTSFIELD, MASS.—A special meeting of the stockholders of the Pittsfield Electric Company will be held this week to act upon the proposition to increase the capital stock of the corporation from $150,000 to $200,000 or $225,000 for the purpose of paying part of the floating debt of the company and to provide funds for laying underground conduits and wires.

NEEDHAM, MASS.—At a recent meeting of the Needham Board of Trade the proposition to sell the municipal electric lighting plant to the Edison Company was discussed. Daniel W. Richards, chairman of the Board of Selectmen, reported an offer of $6,000 from the company for the wires, poles and rights now controlled by the town. He also stated that the company would spend approximately $10,000 in putting the municipal plant into first-class condition if its offer was accepted. The town under the present arrangement purchases the electricity from the company and assumes all cost for repairs and other liabilities in connection with the plant.

CADILLAC, MICH.—Wm. H. Umlor, secretary Electric Land & Development Company, is about to petition the Board of Supervisors of Wexford County for permission to construct and maintain a dam across Manistee River for power purposes.

ANN ARBOR, MICH.—It is reported that Ann Arbor capitalist and a promoter also of this city are contemplating the construction of a new electric railway in Ann Arbor. The line will run from here to Whitmore Lake and probably to Lakeland, two summer resorts of more than local fame.

CROOKSTON, MINN.—The Northwestern Telephone Exchange Company will place its wires underground in the business section of the city.

NASHWAUK, MINN.—The Durgess Electric Company, of Duluth, has secured the contract to construct the municipal electric light plant in this place.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company is nearly ready to deliver electricity from its hydro-electric plant at Taylors Falls, on the St. Croix River, to its sub-station in this city.

BADGER, MINN.—Business men of Roseau, Badger and other towns in this part of the State are agitating the project of an electric railway from Roseau, the county seat of Roseau, to Karlstad, a distance of about forty miles, of which one half has already been graded.

ST. PAUL, MINN.—The Osseo Village Council has granted the North Side Railway Company, of Minneapolis, of which A. B. Robbins is president, exclusive use of the streets of Osseo for an electric railway to connect the village with Minneapolis by Robbinsdale.

BROOKHAVEN, MISS.—It is announced that the Cumberland Telephone Company is to install a new and up-to-date switchboard in its exchange in this town and also contemplates extending its lines to Hattiesburg.

LAUREL, MISS.—The Cumberland Telephone Company has announced its intention of building about 50 miles of toll lines connecting Laurel with points along the Mobile, Jackson & Kansas City Railroad, south to Richton and north along the same line to Bay Springs. D. J. Richey is local manager.

FESTUS, MO.—The Festus Telephone Company, of Festus, has filed a statement dated September 13, of increase of capital stock from $2,500 to $7,500.

MARYSVILLE, MO.—Burns & McDonnell, 709 Dwight Building, Kansas City, have been selected to prepare plans for the municipal water works and electric light plant at Maryville.

ST. LOUIS, MO.—The West End Business Men's Association, of St. Louis, has indorsed the municipal electric lighting plan proposed by the affiliated Business Men's Association.

LOUISIANA, MO.—The Louisiana Gas & Electric Light Company, of Louisiana, filed an affidavit Sept. 18, to show that it had changed its name to the Louisiana Power & Traction Company.

CLINTON, MO.—Wm. F. Hall, of Clinton, was awarded the contract for constructing the municipal electric light plant on Sept. 20 for $30,000. Burns & McDonnell, Dwight Building, Kansas City, are the engineers.

ST. LOUIS, MO.—James Fletcher was appointed receiver for the Martin Reynolds Electric Company, of Little Rock, Sept. 17, by Judge R. J. Lea. The Merco Supply Company, of St. Louis, holds a claim against the company for $3,200 and the State National Bank, of Little Rock, a claim for $1,500. The business will continue under the receivership, and it is believed all claims will be settled in full within a short time.

ANACONDA, MONT.—The Rocky Mountain Bell Telephone Company will install a central energy switchboard in a new exchange.

BUTTE, MONT.—Arrangements have been completed for the erection of the central office building of the Montana Independent Telephone Company. The company has secured a site on West Granite Street at the foot of Alaska Street.

BELGRADE, NEB.—The Belgrade Improvement Company is installing an electric light plant to supply the business portion of this place.

FREMONT, NEB.—The new electric light station, which will cost $50,000, will be built as soon as the bonds, recently issued, have been approved.

HAVELOCK, NEB.—A company has been formed to furnish electric light to Havelock and arrangements have been with the Lincoln Gas & Electric Light Company to supply electricity until a local plant can be established. The parties interested are: A. P. McGeer and A. A. Hyers, of Havelock; Homer Honeywell and Robert Adams, of Lincoln, secretary and superintendent of the Lincoln Gas & Electric Light Company. Mr. McGeer, of Havelock, holds a franchise from the city for the supply of electricity for lighting and under the conditions of the grant the supply must be available within 90 days. The company has a capital stock of $10,000, of which $5,000 has been paid in.

GARDNERVILLE, NEV.—The Truckee River General Electric Company has decided to extend its lines to Gardnerville. Plans are under way for a generating station to be constructed on Carson River, to supply electricity to this place and Minden. B. C. Condit, of Virginia City, is superintendent.

CAMDEN, N. J.—At a meeting of the City Council, held Sept. 21, it was decided to submit the question of whether or not the city should own the electric light plant to the citizens at the coming election.

PRINCETON, N. J.—Wilson, Harris & Richards, architects, Drexel Building, Philadelphia, Pa., have invited contractors to submit bids until Sept. 27, for a power house and heating and electric light apparatus for a group of buildings at Princeton University.

ORISKANY, N. Y.—The question of constructing an electric light plant is reported under consideration here.

WEST SENECA, N. Y.—The Town Trustees have granted a 25-year franchise to the Niagara, Lockport & Ontario Power Company.

CORTLAND, N. Y.—The Common Council on Sept. 18 ratified the contract with the Cortland County Traction Company for lighting the streets for 5 years from Jan. 1, 1907.

FULTON, N. Y.—The Oswego River Power Transmission Company has applied for a franchise to erect poles and other equipment in the streets necessary to transmit electricity for heat, light and power in this city.

MALONE, N. Y.—The Malone, Fort Covington & Hopkins Point Electric Railway Company has obtained water power rights on the Salmon River, near the centre of the railway line, and will install a hydro-electric plant.

NEW YORK, N. Y.—Bids will be received until Oct. 2 by J. A. Bensel, Commissioner Docks, for furnishing and delivering miscellaneous electrical supplies, pipes, fittings, valves, iron, steel, lumber and machinists' supplies.

ILION, N. Y.—The right of way has nearly all been obtained for the proposed Ilion-Morris & Sidney Electric Railway, and it is proposed to

organize a company to construct the road. Judge D. D. McKoon, Ilion, N. Y., is interested.

BABYLON, L. I., N. Y.—The stockholders of the Babylon Electric Light Company have decided to vote on Oct. 5 on the question of increasing the capital of the company from $15,000 to $75,000. The company proposes constructing a new plant.

GOUVERNEUR, N. Y.—Under the terms of the contract made by the village in September, 1904, with the Oswegatchie Light & Power Company to furnish light for the streets of Gouverneur, an all-night service was to be provided after October, 1906. The company now announces that it will be unable to do more than continue the present service, claiming inability at this time to secure the equipment necessary to increase the efficiency of the plant at Hailesboro. The request of the company that the date for furnishing all-night service be extended one year has been granted by the board of village trustees.

GASTONIA, N. C.—G. W. Reagan, of Gastonia, writes that no definite plans have yet been made for developing the water power on Tuckaseege River near Dillsboro.

STATESVILLE, N. C.—The Southern Power Company, of Charlotte, is considering the extension of its line from Charlotte to Statesville. W. S. Lee is vice-president and chief engineer.

DILLSBORO, N. C.—G. W. Reagan and associates, cotton mill manufacturers of Gastonia, N. C., have purchased a water power on Tuckaseege River, near Dillsboro, and it is said that they will develop the water power for the manufacture and distribution of electricity, and also establish a cotton mill.

WAHPETON, N. D.—The Northwestern Telephone Exchange Company will rebuild the local exchange at a cost of $30,000.

GRAND FORKS, N. D.—The Northwestern Telephone Company will take over all the lines of the Great Western Company in Minnesota and North Dakota on Oct. 1.

FARGO, N. D.—The Northwestern Telephone Company has purchased the system of the Fergus Falls Telephone Company and will take possession Oct. 1. The system includes the telephone exchanges in Fergus Falls, Battle Lake and Henning, and 220 miles of toll lines.

MINERVA, OHIO.—The Council is considering the construction of a municipal electric light plant at a cost of about $15,000.

CANTON, OHIO.—It is stated that the Northern Ohio Traction & Light Company, which has recently acquired the Canton-Akron system, is planning to extend the line now running from Massillon to West Brookfield on to East Greenville and Wooster.

CLEVELAND, OHIO.—E. W. Moore, president of the Lake Shore Electric Railway, is engaged on several financing measures to take care of extensions of the Lake Shore Electric system. Bonds to the extent of $500,000 have been sold for the Sandusky, Fremont & Southern branch, and $1,000,000 additional will be sold to pay for the extensions to Tiffin and Fostoria, which will probably be built next year. He will also dispose of about $500,000 of Lake Shore Electric bonds to pay for improvements now being made on the main line, including the installation of a 2,000-kw Parsons turbine in the Avon Beach power station, which will be placed in operation about Nov. 1.

LAKEWOOD, OHIO.—Bids for the proposed sale of the municipal electric lighting plant were opened Sept. 15. Two bids were received for the plant, one from the Cleveland Electric Illuminating Company and the other from the York Electric Company. Both companies put in bids for furnishing electricity for lighting in case the town authorities decided to call upon an outside corporation. The Cleveland Electric Illuminating Company bid $57,500 for the plant as it now stands, and $100 for the franchise. It proposes to supply arc lamps on an all-night schedule at $63.34 a lamp; for moonlight schedule the price is $56.76. The York Electric Company offered to pay $47,900 for the plant and $100 for the franchise. It will supply all-night lamps at $70 each, or moonlight schedule for $66.

TECUMSEH, OKLA.—R. J. Wox, city clerk, writes that M. Griffin O'Neill, of Dallas, Tex., has secured a franchise for an electric light plant.

PORTLAND, ORE.—The hydro-electric plant of the Portland Railway, Light & Power Company at Cazadero, which has been under construction for over a year, is expected to be completed and in operation by Dec. 1.

ECHO, ORE.—The City Council is considering the establishment of a municipal electric light plant, using gasoline engines for motor power.

ROSEBURG, ORE.—A. Welch, of Eugene, general manager of the Willamette Valley Company, has announced that the company has secured the electric plant at Roseburg and that improvements will be made in the plant. The Roseburg plant will be used in connection with the electric railway; the company intends building from Portland south as far as Roseburg. Mr. Welch has also announced that surveys for the Eugene-Springfield electric line and the Eugene street railway system will begin immediately.

READING, PA.—The Brown Engineering Company has been awarded the contract for the new power plant of the glove factory, to be erected by Nolde & Horst Company in this city.

EAST McKEESPORT, PA.—The United Electric Light Company, of Wilmerding, has closed a contract with the borough of East McKeesport for arc lamps at $60 per lamp per year for a term of five years.

WASHINGTON, PA.—It is stated here that contracts will soon be let for the construction of an electric line from Wellsburg to Bethany, W. Va., by the Wellsburg, Bethany & Washington Railway Company.

SHENANDOAH, PA.—The Shenandoah & Suburban Electric Railway Company will begin work in the spring on its proposed road from Shenandoah to Ringtown. H. M. Bradigan, of Shenandoah, is president of the company.

DUNMORE, PA.—The borough of Dunmore has entered into a contract with the Dunmore Electric Light Company to furnish electricity for lighting the streets of the borough for a term of six years beginning Oct. 1, at a cost of $72.50 per lamp per year. This is a reduction of $10 per lamp.

POTTSTOWN, PA.—The Schuylkill Valley Traction Company has obtained possession of the Pottstown & Northern Electric Railway, to be used as a link in its Reading-Philadelphia system. The present name of the road will be retained. Work will soon commence on the extension of the road from Ringing Rocks northward to Swamp, to connect with the Schuylkill Valley branch, which will complete the line to Reading.

ELIZABETHTOWN, PA.—Arrangements are now being perfected by the Royalton & Elizabethtown Street Railway Company for the construction of its proposed line to connect Middletown and Mt. Joy with extensions to Lancaster and Lebanon. The road will be 52 miles in length. E. M. Raymond, Real Estate Building, Philadelphia, Pa., is secretary and treasurer.

KENNETT SQUARE, PA.—It is stated that the West Chester, Kennett & Wilmington Electric Railway Company has in contemplation a number of improvements on its line between Brandywine Springs, Delaware and West Grove. George H. Dodge, superintendent, is quoted as saying that bids are being received for 88 telephone stations on the line, and that they will be erected at an early date. Additional track work is to be done, and additional feed wire and power are to be supplied to the line.

POTTSVILLE, PA.—The following bids were opened by the Borough Council on Sept. 18 for street lighting: Edison Company, five-year contract, from dark to dawn, 137 or more direct-current 9.6 amperes open arc lamps, $75 each per year; alternating-current 7.5 amperes enclosed arc lamps, $70; alternating-current 6.6 amperes enclosed arc lamps, $67.50; magnetite lamps, $65; on the ten-year contract for the foregoing lamps, $5 less per year; 50 or more 32-cp incandescent lamps, with 16-in. diameter white porcelain reflectors, $18 for both five and ten-year contracts; 50-cp, $23 on either five or ten-year contracts; Keystone Contracting Company, five-year contract, 100 incandescent 60-cp boulevard incandescent lamps with iron posts, $25.50 each per year. The Edison Company also bid for lighting the Council Chamber, Police Headquarters and the various fire companies' houses as follows: Incandescent and enclosed arc lamps at meter rate of 10 cents per kw-hour, with a discount of 55 per cent.

PROVIDENCE, R. I.—The Sea View Railroad has petitioned for the right to build an extension in South Kingston.

NARRAGANSETT PIER, R. I.—Sealed proposals will be received at the office of the town clerk until Oct. 7, 1906, for lighting the streets of the village of Narragansett Pier by electricity, gas, gasoline or other artificial light. For full information in regard to the same, address James C. Davis, Narragansett Pier.

CAMDEN, S. C.—The Camden Water, Light & Ice Company is installing a 900-hp Diesel engine in its plant and will soon add a new Warren alternator of 250-kw capacity.

ROCK HILL, S. C.—Bids are wanted for an electric light system and steam plant for lighting the city. Contracts must be closed not later than Dec. 1st and plant ready for operation June 10, 1907. C. S. May is City clerk.

SPARTANBURG, S. C.—The Spartanburg Electric Power & Manufacturing Company has asked for a lighting franchise in this city, and the matter is being investigated by Stanyarne Wilson, city attorney. The company is making hydraulic developments on neighboring rivers for electric purposes.

ABERDEEN, S. D.—The Dakota Central Telephone Company will expend $250,000 in improvements and extensions to its system.

JACKSON, TENN.—It is stated that the line recently completed to Lexington will be extended to Hollow Rock.

CARROLLTON, TENN.—The city has purchased the electric light plant of James E. Jett for $7,500; the plant will be enlarged.

WATERTOWN, TENN.—H. H. Weir writes that the proposed electric light plant which he and W. L. Goodhart proposes erecting here, will cost about $7,000.

MEMPHIS, TENN.—The Lakeview Traction Company is planning to begin within 60 days the construction of its proposed road from Memphis to Clarksdale, Miss. The line will be 63¾ miles in length and will be operated by the single-phase system. The power station and repair shop will be at Lake View Park. H. E. Croft, of Memphis, Tenn., is president of the company.

POLYTECHNIC HEIGHTS, TEX.—An effort is being made to secure an electric light plant in this place.

HOUSTON, TEX.—The Southwestern Telegraph & Telephone Company has petitioned for a franchise to lay conduits on certain streets in the city.

EL PASO, TEX.—Application has been made to the City Council by Frank Tobin and others for a franchise for a new street car system to cover about 15 miles of streets and extend down the valley of Ysleta through the farms below.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company is preparing to establish a sub-station at the power house of the Ogden Rapid Transit Company on Washington Avenue.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has been awarded a contract for furnishing electricity for operating the system of the Ogden Rapid Transit Company in Ogden. H. S. Campbell is manager of the Utah Light & Railway Company.

BURLINGTON, VT.—The Consolidated Lighting Company will soon construct a new transmission line to its plant at Bolton Falls, 18 miles distant, at a cost of $35,000.

RUTLAND, VT.—A franchise has been granted by the board of aldermen to the Home Telephone Company, of Albany, N. Y., to locate and operate a telephone exchange in this city.

BRISTOL, VA.—A committee has been appointed to investigate the cost of establishing a municipal lighting plant.

WISE, VA.—It is reported that the town will issue $30,000 bonds to improve the water works and electric light plant.

LURAY, VA.—The hydro-electric plant of the Luray Electric Light & Power Company, which is being constructed on the Shenandoah River, three miles north of Luray, is nearly completed.

RICHMOND, VA.—The special sub-committee has decided to return the ordinance which provides for the immediate erection of an electric light plant by the city at the old pump house at a cost of $250,000, to the committee on electricity, recommending that it be reported to the Council for immediate passage.

ALEXANDRIA, VA.—The Alexandria Electric Light Company, to which the franchise for supplying this city with electricity for light and power was recently awarded by the Council, is said to have purchased the property of the Osage Manufacturing Company on South Union Street. The new electric plant, which will cost in the neighborhood of $75,000, will, it is expected, be erected and in operation before the end of the present year.

SPOKANE, WASH.—The Interstate Telephone Company will extend its lines outside the city as well as install a local exchange.

GARFIELD, WASH.—This town will soon have electric lights. As soon as the wiring of the town is completed the lights will be turned on.

TACOMA, WASH.—Bids for the rebuilding of the Home Telephone Company's building on D Street are now being received at the office of Russell & Babcock, architects.

SPRINGDALE, WASH.—The new electric lighting plant of J. W. Gillingham is nearly completed and will soon be in operation. The new plant is to be operated by water power.

DAWSON, WASH.—The Dawson Electric Light & Power Company, recently sold under foreclosure of mortgage, has been taken over by N. A. Fuller and others, who are preparing to furnish electricity in the future from the Coal Creek coal mines by a transmission line 50 miles in length.

SEATTLE, WASH.—The Gold Mountain Mining Company, operating the Grand Central claims on Money Creek, near Berlin, in King county, has decided to install at once upon its property a power plant for operating electric drills, a dam for furnishing power to the plant, a 25-ton smelter, and such other machinery as may be necessary for operating the property.

WASHBURN, WIS.—The City will soon vote on buying the water power at Sioux River and erecting a lighting plant there at a cost of $53,640.

ASHLAND, WIS.—The Rhinelander Power Company, which is developing a water power on the White River, has asked the city for a franchise to supply electricity in the city for lighting and power.

MARINETTE, WIS.—F. H. Josslyn, of Oskosh, and others, have secured the water power rights on the Peshtigo River at High Falls and Johnson's Falls. It is said to be the intention to develop the power this year at a cost of about $100,000.

GREEN BAY, WIS.—Part of the equipment for the new power house of the Green Bay Gas & Electric Company has arrived and will soon be installed in the new building, inclusive of a 500-kw Westinghouse-Parsons turbo-generator set and a motor-generator set of 240-kw capacity.

MILWAUKEE, WIS.—The City Council has passed a resolution to purchase the Altpeter site for a municipal electric light plant for $60,000, to be taken from the $150,000 issue of bonds for a lighting plant. A resolution was also passed instructing the city engineer to select an electrical expert, subject to confirmation qf the Common Council, to supervise the building of the plant. A resolution directing the board of public works to prepare plans and specifications for an electric lighting plant was also passed.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railway contemplates the extension of the electric railway service from this city to Chilliwack. The work has received the approval of the managing director and means the construction of 45 miles of line, at a cost of $1,250,000.

NAPINKA, MAN.—The Melita-Arthur Telephone Company, Melita, Man., will build a system to this town and also a system to Waskada.

HESPELER, ONT.—The Town Council has requested the hydro-electric power commission for Ontario to give the municipality an estimate of the price to be charged for 250 to 750 hp of electric energy from the Niagara Falls.

GUELPH, ONT.—Alderman Lyon, secretary-treasurer of the Municipal Niagara Electric Power Union, has received applications from Berlin for 9,000 hp per annum, and from London for 10,000 hp. Waterloo probably will apply at once for about 900 hp and Galt for 2,900 hp. Toronto some time ago applied for 30,000. Port Arthur has applied for 2,000 hp to be developed in the vicinity of the town, but has a further application pending for 50,000 horse power to be taken from Dog Lake, 30 miles away.

MOOSEJAW, SASK.—Charles Thomas, general manager of the Saskatchewan Independent Telephone Company, states his company will shortly install a telephone system in the town of Yellow Grass.

DURANGO, MEX.—The Parral Power & Reduction Company, of Parral, Mexico, is having surveys made for roads and electric transmission lines about 60 miles in length in Durango.

New Industrial Companies.

NEW YORK ELECTRIC INSTALLATION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000. The directors are T. J. Hogan, Julia C. Hall and James P. Law, of New York, N. Y.

THE RICHMOND ELECTRIC SIGN COMPANY, of Richmond, Ind., has been incorporated with a capital of $20,000. The company proposes to establish a plant for the manufacture and installation of electric signs of all kinds.

THE INDIANA CAR & EQUIPMENT COMPANY, of Logansport, Ind., has been incorporated to manufacture cars and equipment of all kinds. The plant will be established in this city. The capital stock is $50,000. J. L. Smith, C. H. Pennington, F. J. Lewis, H. A. Dorner and H. R. Adams are the directors.

THE CONNALLY-McILHERAN ELECTRICAL ENGINEERING COMPANY, of Chattanooga, has been incorporated, with a capital stock of $10,000. The company proposes to do consulting and constructing engineering, sell electrical machinery and supplies of all kinds and do all kinds of repair work. The engineers identified with this company are W. B. Connally, W. C. McIlheran, W. C. McAfee and H. A. Clark.

New Incorporations.

CARLYLE, ILL.—The Clinton County Telephone Company has sold its entire holdings in this county to the Citizens Telephone & Telegraph Company for $11,000. It will be operated in connection with the Central Union Company.

HARRISBURG, ILL.—The Harrisburg Independent Telephone Association has been incorporated, with a capital stock of $2,500, to maintain and operate a telephone system. The incorporators are John T. Wheatley, W. D. McIlrath, A. P. Brown and others.

DEKALB, ILL.—The DeKalb Telephone Company has been organized with a capital stock of $25,000 and the following officers: B. F. Wyman, of Sycamore, president; A. S. Bean, of Waterman, vice-president; C. M. Campbell, of Genoa, secretary and treasurer.

MOLINE, ILL.—A charter has been granted to the Moline, Rock Island & Eastern Traction Company, with a capital stock of $5,000, to construct a railroad to Carbon Cliff, and also from Rock Island to Galesburg. The incorporators and directors are Joseph F. Porter, James F. Lardner, Frank G. Young, Herbert E. Casteel and Burton F. Peek.

MASON CITY, IA.—The People's Gas & Electric Company has been formed at Mason City, with a capital stock of $800,000, its object being mainly to distribute gas, etc., and to develop natural gas territory.

EMINENCE, KY.—The Henry County Light & Power Company has been organized with a capital stock of $40,000.

GUEYDAN, LA.—The Farmers' Mutual Telephone Company, Ltd., has been organized with a capital stock of $5,000, to build a line to Lake Arthur, Shell Beach and Klondike; one to Relift, seven miles east of the town, and one seven miles west of the town. Henri L. Gueydan was elected chairman and William M. Cowan, secretary.

NEW ORLEANS, LA.—The St. Bernard Traction Company, of New Orleans, has been organized with a capital stock of $300,000, for the purpose of constructing and operating an electric railway from the Stock Landing to the district Court House. A meeting will be held in a few days to elect the officers and board of directors. It is understood that the New Orleans Railway & Light Company is interested in the project.

NEW ORLEANS, LA.—The Bayou Teche Railway & Light Company has been incorporated in this city, with a capital of $500,000 authorized. The directors are: F. A. Longshore, J. W. Porch, Casper Trumpy, F. A. Daniels and Paul M. Schnidau. The company will first equip the city of New Iberia with a first-class system of railways and lighting, and then expects to extend to other Teche towns. It will also furnish electric lights to the towns and plantations along the route.

NEVADA, MO.—A new telephone company has been organized and will be known as the Nevada-Tucker Lake Telephone Company. This company's lines will connect with the Bell lines in Nevada and will be some twelve miles long. The officers are C. S. Pheils, president; B. J. Moncrief, secretary, and A. E. Seifkes, treasurer.

BIG TIMBER, MONT.—Articles of incorporation have been filed for the Dry Creek Telephone Company by F. M. Loup and others. The company has a capital stock of $10,000, and proposes to construct a telephone line from Big Timber to Grey Cliff.

JERSEY CITY, N. J.—Muscatine Light & Traction Company has filed articles of incorporation, with a capital stock of $600,000. The incorporators are H. O. Coughlin and others.

NEW YORK, N. Y.—The Delaware & Otsego County Independent Toll Line Company, with a capital of $15,000, has been incorporated by O. L. Tipple and others.

AU SABLE FORKS, N. Y.—The Essex County Traction Company has been formed at Au Sable Forks, to operate an electric road forty-nine miles long from Westport on Lake Champlain, to Newman; capital, $1,500,000. Directors, A. L. Washburn and E. S. Goodrich, Hartford, Conn.; William L. Kiley, Glens Falls.

ALBANY, N. Y.—The Essex County Traction Company has been incorporated with a capital stock of $1,500,000, to operate an electric line from Westport, on Lake Champlain, to Newman, a distance of 49 miles. The directors are: Albert L. Washburn, Norman C. Spencer, Henry F. Smith, Wilbur T. Halliday and E. S. Goodrich, of Hartford, Conn.; George S. Raley, William L. Kiley and Thomas D. Trumbull, of Glens Falls and R. L. Trumbull, of Ausable Forks.

INDIAN FIELDS, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Indian Fields Telephone Company. The incorporators are Philip R. Whitbeck, W. D. B. Lester, Charles R. Whitbeck, A. C. Koonz, George E. Dickinson, A. D. Caldwell, Daniel Snyder, Wheelock Udell, of Indian Fields, and R. J. Houck, of Keefer's Corners. The line will extend from Waterloo to Indian Fields and thence to Keefer's Corners.

KENMARE, N. D.—The Kenmare Light & Power Company, with a capital of $50,000, has been incorporated by A. B. Kerlin and others.

ZANESVILLE, OHIO.—The Muskingum Light, Heat & Power Company has been incorporated with a capital of $10,000, to build locks and dams along Muskegon River, power house, etc., and furnish electricity for lighting, etc. The incorporators are James T. Holmes and others.

YORK, N. D.—The York Telephone Company has been organized and incorporated. W. W. Wirtz is president.

FARGO, N. D.—The Pomona Valley Telephone Company has been organized at a recent public meeting. A constitution and by-laws were adopted. The following directors were elected: L. A. Ueland, president; L. P. Ormsby, vice-president; O. A. Thompson, secretary; C. M. Washburn, treasurer; C. W. Oakley. By a unanimous vote the directors were instructed to put in an independent exchange at once.

MALTA, OHIO.—The Malta-Elliott Telephone Company, with a capital of $10,000, has been incorporated by Lee Humphrey and others.

ELLIOTT, OHIO.—The Elliott Telephone Company has been formed with a capital stock of $7,500, to operate an exchange system in that place.

AKRON, OHIO.—The Independent Telephone Building Co. has been incorporated with a capital of $25,000. The incorporators are Chas. H. Lahr and others.

ELYRIA, OHIO.—The Oak Point & Elyria Railway Company has been incorporated to build an electric line from Elyria to Amherst and thence to Oak Point. The incorporators are: E. S. Cook, F. S. McGowan, A. R. Manning, M. Dicke and M. L. Fowles.

ELGIN, ORE.—The Elgin Light & Power Company has installed a new 2,400-light dynamo to take the place of the one now in use which furnishes current to only 500 lamps.

GAINES, PA.—Elk Run Telephone Association has been incorporated with a capital of $5,000 to build a line in Potter and Tioga Counties.

PITTSBURG, PA.—The Lawrenceville Street Railway Company, with a capital of $12,000, has been incorporated by Edwin K. Morse and others, to build a line from the Pittsburg Subway line at Neville Street to Hartford Street.

HARRISBURG, PA.—The Middletown Telephone Company has been chartered with a capital stock of $20,000. The central exchange will be in Middletown and the main offices in Harrisburg. The incorporators are B. F. Meyers, Frank D. Houck, Frank E. Zeigler, W. P. Beardsley, of Harrisburg, and S. P. Light, of Lebanon. B. F. Meyers is president of the company.

PALO ALTO, PA.—The Palo Alto Heat, Light & Power Company has been chartered with a capital stock of $5,000 for the purpose of furnishing electricity for heat, light and power in the borough of Palo Alto. The charter was procured by D. W. and S. H. Kaercher. The new company is an adjunct of the Eastern Railways Company, which has purchased the local electric line and various light companies in this section.

WEST CHESTER, PA.—A charter has been granted to the Coatesville, Thorndale & Downington Railroad Company, with a capital stock of $50,000. This is believed to be in the interests of the West Chester Electric Railways to enable it to complete the building of its trolley road from Gallagherville to Cain Station, and thus finish the line between Downingon and Coatesville, which has been held up by property owners for the last two years or more.

PORTLAND, PA.—The Portland, Pa., Power Company, with a capital of $800,000, has been incorporated at Trenton, N. J., with the right to erect dams, build power houses, generate electricity, deal in electricity and ice. It is stated that the concern is to erect an immense power house along the Delaware River, at Foul Rift, a few miles south of Belvidere, for the purpose of supplying power and light to suburban trolley companies and to the towns and cities in the vicinity.

LEWISBURG, PA.—A charter has been issued to the Lewisburg & Mifflinburg Electric Railway Company at the State Department, at Harrisburg, the line to be ten miles and to connect the county towns of Union and Snyder. The capital stock of the new company is $60,000, and it will build a line from the center of Lewisburg through Linntown, Lochielon and Vicksburg to Mifflinburg. The officers and incorporators of the new company are: J. B. Nuss, Bloomsburg, president; J. M. Nuss, Nescopec, secretary, and O. B. Mellick, Bloomsburg, treasurer. these officers and the following constituting the board of directors: J. M. Sherer, Bloomsburg, and George A. Geyer, Mifflinburg.

COLUMBIA, S. C.—A charter has been granted to the Garren Electric Company, with a capital of $10,000. Incorporators: U. R. Brooks, Jr., Luther Garren and S. T. Carter.

PETROS, TENN.—Articles of incorporation have been filed for the Petros Electric Light Company, with a capital stock of $5,000. The incorporators are A. H. Wood, C. J. Jackson, J. R. Gott, W. H. Nelson and M. W. Burch.

ABILENE, TEX.—The Abilene Gas Light, Fuel & Power Company has been incorporated with a capital of $50,000 by J. M. Radford, W. M. Lacy and others.

WEIR, TEX.—The Walberg-Weir Telephone Company has filed articles of incorporation with a capital of $2,000. The incorporators are Frank Doering and others.

HOLLAND, TEX.—Articles of incorporation have been filed for the Holland Independent Telephone Company with a capital stock of $7,000 by W. R. Wallace and others.

Obituary.

MR. H. ROBINSON.—The death is announced of Mr. Henry Robinson, of Akron, O., from heart disease. He was a banker and manufacturer there and was at the head of the syndicate interested in the enterprise for building an electric road between Omaha and Lincoln, Neb.

MR. T. E. HAMBLETON.—Mr. T. Edward Hambleton, the founder of the Baltimore banking firm of Hambleton & Co., died at his country seat, near Baltimore, last week, aged 78. He was one of the organizers of the Consolidated Gas Company of Baltimore, and for many years president of the Baltimore Traction Company.

MR. A. S. BROWN.—We regret deeply to note the death of Mr. Alfred S. Brown, for many years chief electrical engineer for the Western Union Telegraph Company. He died in this city on Sept. 25. He began as an operator and worked his way through various positions until he became superintendent of the Eastern district. He held this position for ten years, until he was made chief electrician for the company. Mr. Brown was born 71 years ago. In 1870 he married Margaret A. Sheldon, of Milton, Mass. He leaves a widow and two daughters. Mr. Brown was a man of marked ability, and his foresight was evidenced by the fact that he was one of the first to appreciate the work of Mr. Nikola Tesla in the development of the rotating field and other inventions, and to give him financial support.

MR. P. F. KOBBE.—It is with deep regret we record the death of Mr. Philip F. Kobbe, vice-president and treasurer of the Westinghouse Electric Manufacturing Company, at his country place in Stockbridge, on September 21. He had been ill for several weeks. Mr. Kobbe was born in New York on Oct. 24, 1842, and was educated in Germany. He served in the civil war as a member of the Seventh Regiment. He was prominently associated with the old United States Lighting Company when it was absorbed, in 1890, by the Westinghouse Company, and was then elected vice-president and treasurer of the corporation. He was also identified with the British and French Westinghouse companies. Mr. Kobbe was a member of the Calumet and Richmond Country Clubs and the Society of the Colonial Wars. A wife and five children survive him.

Personal.

MR. F. P. FISH, president of the American Telephone & Telegraph Company, is expected home soon from his trip to Europe.

MR. DUDLEY FARRAND, of the Public Service Corporation of New Jersey, has just returned from a European trip and vacation.

MR. F. DAGGER, of Winnipeg, Man., has been appointed one of the telephone experts for the Manitoba Government in connection with the proposed government owned lines.

FRANK O. CUPPY, of Lafayette, Ind., has been elected manager of the Lafayette Independent Telephone system, succeeding O. T. Friberg, who will become secretary of the telephone company.

MR. H. H. CARR, of Newport News, has been appointed general manager of the Raleigh Street Railway Company, as a result of the acquisition of a controlling interest in the company by the Bond & Electric Company.

MR. H. M. DAVIS, manager of the advertising department of the Sprague Electric Company, and treasurer of the Technical Publicity Association, has just returned to work from a vacation spent in the mountains.

MR. RICHARD McCULLOCH, the well-known electrical engineer and street railway manager, is to marry on October 10, at Milwaukee, Wis., Mary Grace Beggs, daughter of President John I. Beggs, of the Milwaukee Railway & Light Company.

MR. FRANCIS H. ELY has been appointed electrical engineer of the Union Railway Company, of New York, to succeed Mr. R. E. Bennings, resigned, who is now in charge of important work at Lima, Peru, for W. R. Grace & Company, of New York, N. Y.

MR. W. L. MADGEN, who is prominently connected with English lighting and traction interests, has been visiting this country during the past month and returned suddenly last week, on the "Deutschland," bringing his trip to a close earlier than was expected. While here he took part in the Edison convention at the Thousand Islands.

MR. LOCKE ETHERIDGE, formerly with the Stanley Electric Mfg. Company, and the Northern Electric Mfg. Company in Chicago, has accepted a position with The Avery Scale Company, of North Milwaukee, and has been appointed in charge of their Chicago territory.

MR. D. D. COLVIN, who recently resigned as general manager and treasurer of the Seattle-Tacoma Power Company, has announced that he will hereafter be associated with William Piggott, president of the Seattle Car Manufacturing Company, which has its plant at Youngstown.

PROF. H. S. CARHART.—Advices from Ann Arbor, Mich., say: "Prof. H. S. Carhart, author of the high school text-book "Carhart's Physics," who was given leave of absence by the Board of Regents of the University for a year in order to enable him to attend the sessions of the international commission on electrical units and standards to be held next month at London, England, will not be obliged to take advantage of the absence on account of the postponement of the sessions for a year."

MR. H. W. BEEDLE, who for four years past has been chief engineer of the New York operating department of the Electric Storage Battery Company of America, has accepted an important engineering position with the Bell Telephone Company of Canada. Mr. C. J. Welcke, the assistant engineer, succeeds to his position in New York, and Mr. H. L. Davisson of the same department, takes Mr. Welcke's place. Mr. Beedle is a Canadian by birth, and takes with him to the Dominion the warm esteem and good will of his associates on this side.

MR. J. H. LYONS, for the past year manager of the copper country district for the Michigan State Telephone Company, has been transferred to Detroit, where he will be traffic manager. His successor has not been named, and pending the appointment Assistant General Superintendent Johnson will be in charge.

MR. FRANK H. TAYLOR, until recently vice-president and director of the Westinghouse Electric & Manufacturing Companies, resigning early in the summer to make a long European trip, has become first vice-president of the Yale & Towne Manufacturing Company, of Stamford, Conn., interests with which he was connected at an earlier stage of his manufacturing career and to which he now takes a ripe and matured engineering experience of unusual extent. Mr. Taylor will be as hitherto a familiar figure in New York and at the Engineer's Club, of whose board of trustees he is a member.

Trade Publications.

KNIFE SWITCHES.—The Stanley-G. I. Electric Mfg. Company, Pittsfield, Mass., has issued bulletin No. 606, dealing with front and back connected knife switches for 250-volt direct-current and 500-volt alternating-current circuits.

SWITCHES.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has issued a neat folder entitled "How Shall We Know Good Switches?" which attempts to show a few of the weaknesses existing in nine-tenths of the switches on the market and explain the good features of the Trumbull switches.

STEEL PRESSURE BLOWERS.—Bulletin No. 134 in the Sturtevant Engineering Series has just been issued by the B. F. Sturtevant Company, Hyde Park, Mass. It is entitled "Steel Pressure Blowers," and relates to high pressure types of fan blowers for foundry and similar uses. It contains a valuable table of fan capacities for various size foundry cupolas.

MILLING MACHINES.—Catalogue No. 44 of the Newton Machine Tool Works, 24th and Vine Streets, Philadelphia, Pa., gives a well-illustrated description of keyseat milling machines. These machines are provided with both horizontal and vertical spindles. No setting of work, beyond the placing of the shaft in V-blocks, is required, and a perfectly finished keyseat is obtained.

News of the Trade.

MORSE CHAIN COMPANY has removed its plant from Trumansburg, N. Y., to Ithaca, N. Y., where it will enjoy increased facilities.

THE CHAS. J. JAGER COMPANY, of Boston, have recently established an electrical engineering department in connection with its mechanical engineering business, and invite correspondence on the subject. Mr. E. T. Lincoln, of Brookline, is in charge of the department.

BUCKEYE ELECTRIC COMPANY.—The Buckeye Electric Company, of Cleveland, has opened a Texas branch office at 216 Commerce Street, Dallas. It will be in charge of Mr. H. E. Wells, who will look actively after the sale of Buckeye incandescent lamps in that territory.

NOVELTY INCANDESCENT LAMPS.—Pres. R. K. Mickey, of the Novelty Incandescent Lamp Company, of St. Mary's, Pa., advises us that on and after September 20, its office will be located at the new lamp plant at Emporium, Pa., where all correspondence, telegrams, etc., should be sent, and all inquiries and orders addressed.

ST. LOUIS, MO.—The American De Forest Wireless Telegraph Company, which has had headquarters in St. Louis since the World's Fair, is to be removed to New York and a branch of the company only will be maintained here. The furnishings of the office are being prepared for shipment. None of the scientific apparatus in use in the local stations will be removed.

THE NATIONAL BRAKE & ELECTRIC COMPANY, Milwaukee, Wis., reports among recent orders the following: Chicago City Railway Company, 100 equipments; Louisville, Ky., Traction Company, 150 equipments; Philadelphia Rapid Transit Company, 164 equipments; Jersey City, Hoboken & Paterson Street Railway, 20 equipments; Public Service Corporation of New Jersey, 47 equipments; Birmingham, Ala., Railway, Light & Power Company, 20 equipments; W. R. Grace & Company, exporters, Hanover Square, N. Y., 10 equipments; Pensacola, Fla., Electric Terminal Railway Company, 9 trailer equipments; Memphis Street Railway Company, 20 equipments; Oakland, Cal., Consolidated Traction Company, 20 equipments; Chattanooga Railways Company, 12 equipments; R. W. Blackwell & Company, Ltd., London, England, 40 compressors and governors and 6 equipments; Mobile, Ala., Light & Railroad Company, 9 equipments; Sheffield, Ala., Company, 10 equipments; Kansas City, Mo., Western Railway Company, 8 equipments; Connecticut Railway & Lighting Company, 7 equipments; Dallas, Tex., Consolidated Electric Street Railway Company, 4 equipments; Spokane, Wash., Traction Company, 4 equipments; York, Pa., Street Railway Company, 6 equipments; Michigan United Railways Company, Kalamazoo, 2 equipments; Jeffrey Manufacturing Company, Columbus, O., 2 equipments; Metropolitan Street Railway Company, Boston, 2 equipments; Knoxville, Tenn., Railway & Light Company, 3 equipments.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 18, 1906.
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

831,071. SAFETY DEVICE; George H. Hill, Montreal, Quebec. App. filed July 7, 1902. Relates to a form of magnetic circuit breaker or cut-out, and consists briefly in including the coil of an electro-magnet in the circuit to be protected, said electro-magnet attracting its armature in case of overload to directly trip the circuit breaking lever.

831,101. DEVICE FOR SINGLE-PHASE COLLECTOR-MOTORS WITH COMPENSATION-WIRING; Rudolf Richeter, Wilmersdorf, near Berlin, Germany. App. filed Nov. 21, 1905.

831,103. APPARATUS FOR THE THERAPEUTIC USE OF RADIANT ENERGY; Albert Ripperger, New York, N. Y. App. filed May 24, 1905. A cylindrical housing is supported by a vertical standard and contains an X-ray tube which may be set to operate in any direction.

831,131. MULTICONDUCTOR CABLE; Walter C. Yeatman, Chicago, Ill. App. filed June 13, 1903. In order to avoid cross induction effects in "phantom" telephone circuits, the patenteee has the cables stranded with four insulated conductors each having two pairs of helically twisted conductors, one of which is twisted in the opposite sense from the other, the pairs being twisted around one another.

831,186. ELECTRIC HEATING UNIT; Earl H. Richardson, Ontario, Cal. App. filed Dec. 19, 1905. The base of a flatiron is insulated from the upper part by an asbestos plate, and the lower section has a pair of resistance coils embedded therein by which it may be heated.

831,168. INSULATOR; Arthur J. L. Lembeck. Sioux City, Ia. App. filed Nov. 26, 1904. The insulator has a lateral knob projecting from one side which is used to attach the lines from a telephone or fire alarm circuit.

831,226. ELECTRIC CUT-OUT; Frank B. Hinkson, New Castle, Pa. App. filed Mar. 25, 1905. Appliance for use with water purifiers where an electric current is passed through the water in a supply pipe to sterilize the same. Current is automatically cut off when the water pressure ceases.

831,244. COMBINED MECHANICAL AND ELECTRIC MOTIVE POWER FOR TRAINS; George G. Schroeder, Washington, D. C. App. filed Apr. 17, 1905. The axles of one of the trucks are driven by a steam engine and a dynamo is effective to transmit a portion of the power to electric motors on the remaining trucks.

831,269. STORAGE-BATTERY ELECTRODE-PLATE; Thomas A. Edison, Llewellyn Park, N. J. App. filed Mar. 5, 1903.

831,282. ARC LAMP; Alvin Hausold, Allegheny, Pa. App. filed Jan. 12, 1906. Mechanical construction of an arc lamp in which the carbon clutch and armature can be readily removed and replaced without disturbing any permanent electrical connections.

831,284. PROTECTIVE DEVICE FOR VENTILATING FANS; Robert A. Ilg, Chicago, Ill. App. filed Feb. 3, 1905. In order to avoid the corrosion of fan motors exposed to chemical gases, the patentee surrounds the motor with a hood having a pipe connection with a source of pure air supply.

831,288. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 22, 1905. A device for avoiding sparking or sticking in the receiving device of a telegraph installation. Patentee provides means dependent on the movement of movable part of a translating device in the circuit, to establish shunt around the relay.

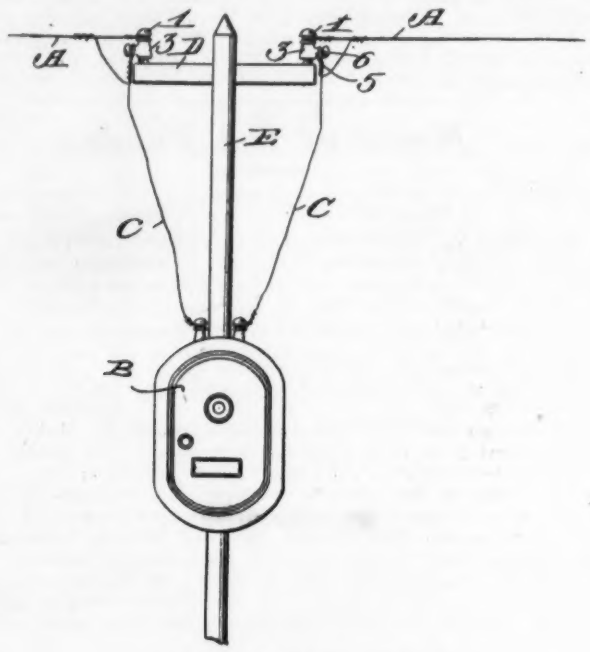
831,304. ELECTRIC CONTROLLER; Charles E. Shedrick, Sherbrooke, Quebec. App. filed Aug. 12, 1905. A horizontally disposed hollow cylinder contains mercury adapted to establish contacts when the drum is tilted and a solenoid magnet is effective to rock the drum when desired.

831,321. INSULATING MATERIAL AND PROCESS OF MANUFACTURING SAME; Johann Billwiller, Goldach, Switzerland. App. filed Apr. 19, 1904.

831,327. POST AND BOX FOR CABLE-TERMINALS AND THE LIKE; Benjamin F. Daly, New York, N. Y. App. filed Dec. 15, 1905.

831,338. INSULATOR; Monroe J. Glick, Westfield, Ill. App. filed Oct. 2, 1905. A cylindrical block of porcelain is notched laterally and axially to receive the circuit wire, the notches being formed so as to lock the circuit wire in place.

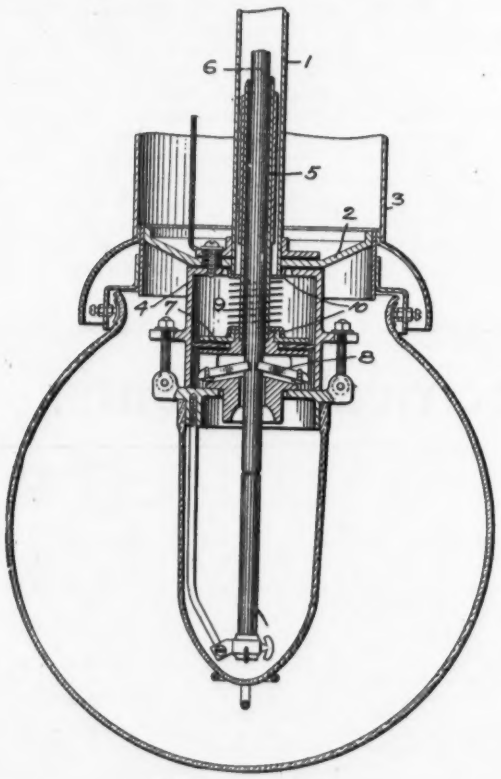
831,348. TELEPHONE-RECEIVER SUPPORT; Frank F. Howe, Marietta, O. App. filed Mar. 31, 1906.



831,168.—Insulator.

831,355. TELEGRAPHIC TRANSMITTING DEVICE; Isidor Kitsee, Philadelphia, Pa. App. filed June 21, 1906. A transmitting device employing the two sources of current of unequal force connected in opposition to the line, a transmitting key adapted to shunt one of said sources, and an inductive resistance in the region of said shunt.

831,364. SELECTOR OR LOCKOUT FOR PARTY-LINES; Alexis Marchand, Buckingham, Wash. App. filed Sept. 5, 1905.



831,282.—Arc Lamp.

831,376. RAILROAD SIGNALING; Petrus J. Portman, Amsterdam, Netherlands. App. filed July 6, 1905. A special trolley is provided in a steam railroad and the switches of the track are arranged to establish an alarm circuit therewith when improperly positioned.

831,400. ELECTRIC VAPOR-LAMP; Howard I. Wood, Schenectady, N. Y. App. filed July 21, 1902.

831,401. VAPOR ELECTRIC APPARATUS; Howard I. Wood, Schenectady, N. Y. App. filed Mar. 31, 1904.

831,404. CONTROLLING SWITCH; Henry P. Ball, New York, N. Y. App. filed Feb. 23, 1905. Relates to the distant control of electric motors for breaking high potential circuits. Has a double throw control switch which may be held closed in either position and means for indicating which way the switch was last thrown.

831,412. TROLLEY WHEEL; John Brown, Camden, N. J. App. filed Dec. 16, 1905. A pair of supplemental trolley wheels are journaled beside the usual wheel so as to receive the conductor in case the trolley leaves the wire.

831,430. INCANDESCENT LAMP SOCKET; James J. Hartley, Schenectady, N. Y. App. filed Apr. 27, 1905. The base is recessed on one side and has a metallic clip thereon constituting the terminal and the central stud contact. Also has special construction of switch.

831,431. CONTROL OF BULKHEAD DOORS; Laurence A. Hawkins, Schenectady, N. Y. App. filed Dec. 29, 1905. The bulkhead doors are closed by electric motors through a worm and wheel connection. In case the door strikes an obstruction, the additional end thrust on the worm becomes effective to open the motor circuit.

831,434. WATER-PURIFIER; Frank B. Hinkson, New Castle, Pa. App. filed Oct. 7, 1905.

831,442. INDUCTOR-ALTERNATOR; Charles A. Kelsey, Pittsfield, Mass. App. filed July 6, 1905.

831,446. ALTERNATING-CURRENT MOTOR; Marius C. A. Latour, Paris, France. App. filed Jan. 21, 1905.

831,451. SYSTEM OF MOTOR CONTROL; Charles E. Mandelick, New York, N. Y. App. filed Dec. 19, 1905. Relates to means for starting and stopping a motor from any one of a plurality of stations without disturbing the main controller after it has been brought to running position. These additional switches are in the nature of emergency stops.

831,467. TROLLEY HEAD; William H. Pfrimmer, New Albany, Ind. App. filed Nov. 2, 1905. The harp carries a pair of arms which may be projected upward beside the trolley wheel when guiding the latter on to the wire. When the arms are returned a pair of small guiding wheels are positioned to hold the trolley wheel against leaving the wire.

831,474. ELECTROLYTIC DIAPHRAGM; Isaiah L. Roberts, New York, N. Y. App. filed Dec. 23, 1904.

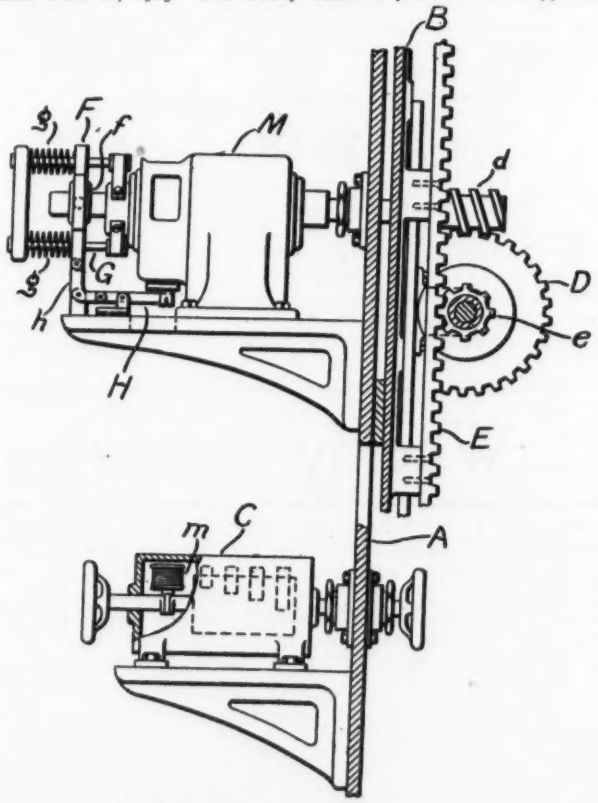
831,475. INDUCTOR-ALTERNATOR; David B. Rushmore, Schenectady, N. Y. App. filed Oct. 5, 1905.

831,478. METERING SYSTEM; Ernest Schattner, Schenectady, N. Y. App. filed Aug. 19, 1905. A method for metering electric energy by which the charges are made proportional to the cost of supplying the energy. Has a different rate of charge when the consumer uses above a maximum number of lamps.

831,482. ELECTRIC HAMMER; Robert Smith, Middletown, O. App. filed Aug. 8, 1905. A power hammer having a movable solenoid which is guided to and fro in a cylindrical casing so as to impinge against the tool and give the hammer, blow. The movements of the solenoid cause the making and breaking of its circuit.

831,490. ELECTRIC CIGAR LIGHTER; Julius C. Tournier, Schenectady, N. Y. App. filed Sept. 25, 1905. A casing has a handle thereon and a resistance wire is wound on an insulated plug at one side of the casing so as to become incandescent for the purposes of a cigar lighter.

831,409. TROLLEY; Jacob T. Haudenshield, Scott Township, Pa. App. filed Nov. 10, 1905. The trolley wheel is journaled on supplemental



831,431.—Control of Bulkhead Doors.

arms at the upper end of the trolley pole which normally move into a vertical position. When the wheel strikes an obstruction, the arms are capable of a rearward yielding movement.

831,525. COMPOSITE TELEPHONY AND TELEGRAPHY; Harry O. Rugh, Chicago, Ill. App. filed Jan. 13, 1903.

831,526. SIGNALING APPARATUS; Harry O. Rugh, Chicago, Ill. App. filed Jan. 8, 1904. A relay having a polarized armature is used with an signaling current for polarizing the relay alternately, thereby effecting the operation of the armature and a signal producing device governed by the armature.